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State of Connecticut

REPORT

OF

The Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

FOURTEENTH REPORT OF THE STATE ENTOMOLOGIST, 1914

W. E. BRITTON, PH. D.

BEING PART III OF THE ANNUAL REPORT OF 1914

FOURTEENTH REPORT
OF THE
STATE ENTOMOLOGIST
OF
CONNECTICUT

FOR THE YEAR 1914

BY
W. E. BRITTON, PH. D.
State Entomologist

New Haven, Conn.
1915

THE WILSON H. LEE COMPANY,
NEW HAVEN, CONN.

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NOTE REGARDING AUTHORSHIP.

For bibliographical purposes all matter in this report should be credited to W. E. Britton; unless otherwise stated.

ILLUSTRATIONS.

The plates are all from photographs: IX, a. by Quincy S. Lowry; XIX, b. by J. B. Rorer; XXII, a. by H. A. Doty (from Rept. 1901); XXIV b. by D. B. Pangburn; all others by B. H. Walden.

The text figures are all from drawings by B. H. Walden, and figures 4 and 6 are from the Report of 1908.

PART III.

FOURTEENTH REPORT

OF THE

State Entomologist of Connecticut

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I beg leave to submit the following as my fourteenth report as State Entomologist of Connecticut for the fiscal year ending September 30, 1914. Some of the nurseries were inspected and the certificates issued later than that date, but they have been included because it was desirable to have on one list all nurseries inspected during the Calendar year.

Respectfully submitted,

W. E. BRITTON,
State Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM OCTOBER 1ST, 1913, TO SEPTEMBER 30TH, 1914.

Insect Pest Account.

RECEIPTS.

From E. H. Jenkins, Treasurer.....	\$4,000.00
Account of 1913, balance.....	430.09
	\$4,430.09

EXPENDITURES.

For Field, office and laboratory assistance:

B. H. Walden, salary.....	\$1,500.00
Q. S. Lowry, salary.....	716.65
I. W. Davis, salary.....	125.00
M. P. Zappe, salary.....	375.00
Frances M. Valentine, salary...	520.00
Other assistance.....	60.00
	\$3,296.65

Printing and illustrations.....	17.28	
Postage.....	58.93	
Stationery.....	24.90	
Telegraph and telephone.....	3.15	
Office supplies.....	18.43	
Library.....	106.46	
Laboratory apparatus and supplies.....	94.31	
Express, freight and cartage.....	2.98	
Tools and supplies.....	6.55	
Traveling expenses.....	299.92	
Balance, cash on hand.....	500.53	
		\$4,430.09

*Gypsy Moth Control Account.**

RECEIPTS.

From E. H. Jenkins, Treasurer.....	\$4,000.00
Account of 1913, balance.....	600.33
	\$4,600.33

EXPENDITURES.

For Salaries, board of scouts, etc.:

I. W. Davis, salary.....	\$ 875.00	
Q. S. Lowry, salary.....	233.33	
F. J. Rimoldi, salary.....	451.50	
Other assistance, labor, etc.....	1,513.35	
Board of scouts.....	538.95	
		\$3,612.13
Printing and illustrations.....	265.30	
Postage.....	.56	
Telegraph and telephone.....	11.85	
Express, freight and cartage.....	5.88	
Rental of storehouse.....	18.00	
Tools and supplies.....	54.07	
Traveling expenses:		
Inspecting imported stock.....	\$382.32	
Other work.....	247.83	
		630.15
Balance, cash on hand.....	2.39	
		\$4,600.33

Memorandum:—These accounts of the State Entomologist have been duly audited by the State Auditors of Public Accounts.

* Including cost of inspecting imported nursery stock.

SUMMARY OF INSPECTION AND OFFICE WORK.

OCT. 1, 1913, TO SEPT. 30, 1914.

- 439 samples of insects received for identification.
- 74 nurseries inspected
- 74 regular certificates issued
- 40 parcels inspected and certificated.
- 75 orchards and gardens examined.
- 303 shipments, 1,477 cases, 1,646,130 plants, imported nursery stock inspected.
- 58 shipments found infested with insects or fungi.
- 463 apiaries, containing 3,882 colonies inspected.
- 151 apiaries containing 543 colonies found infested with European foul brood.
- 5 apiaries containing 27 colonies found infested with American foul brood.
- 12 apiaries containing 28 colonies found infested with Sac or Pickled brood.
- 2588 letters written on official work.
- 60 circular letters sent out.
- 313 reports of inspection to Federal Horticultural Board.
- 1350 bulletins, etc., mailed on request or to answer inquiries.
- 106 packages sent out by mail or express.
- 20 lectures and addresses made at institutes, granges, etc.

PUBLICATIONS OF ENTOMOLOGICAL DEPARTMENT, 1914.

- Thirteenth Report of the State Entomologist (Part III of Station Report for 1913): 77 pages, XII plates: 10,000 copies distributed in February.
- Bulletin 181, "Some Common Lady Beetles of Connecticut," 24 pages, 24 figures: 10,000 copies distributed in April.
- Bulletin 182, "The Brown-Tail Moth," 26 pages, 16 figures: 12,000 copies distributed in April.
- Report of Committee on Injurious Insects; Proceedings Connecticut Pomological Society, page 47, 5 pages, 1914. (Also printed in *Connecticut Farmer*, Feb. 14, 1914.)
- Mites on Snapdragon; *Florist's Exchange*, Vol. XXXVII, page 557, March 7, 1914. (Brief note.)
- Spray Mixtures for Orchard and Garden; *Rural New Yorker*, March 7, 1914.
- Some Problems in Economic Entomology; *Connecticut Agricultural College Outlook*, page 117. 2 pages, Feb. 14, 1914.
- "New Jersey State Anti-Mosquito Convention" at Atlantic City, N. J., *Journal of Economic Entomology*, Vol. VII, page 244, 2 pages, April, 1914.
- A Remarkable Outbreak of *Culex pipiens*; *Journal of Economic Entomology*, Vol. VII, page 257, 2½ pages, June, 1914.
- The Army Worm; *Connecticut Farmer*, July 25, 1914.

The Army Worm; *Rural New Yorker*, August 22, 1914, page 1027; continued August 29, page 1047; 6 figures.

Two Oncoming Insect Pests; *Tree Talk*, 1½ pages, May, 1914.

ENTOMOLOGICAL STAFF.

W. E. BRITTON, PH. D.....	<i>State and Station Entomologist.</i>
B. H. WALDEN, B. Agr.....	<i>First Assistant.</i>
QUINCY S. LOWRY, B. Sc.....	<i>Assistant.</i>
IRVING W. DAVIS, B. Sc.....	<i>Assistant.</i>
MAX P. ZAPPE, B. S.*.....	<i>Assistant.</i>
MISS FRANCES M. VALENTINE.....	<i>Stenographer.</i>

As in former years, Mr. Walden has continued as first assistant, and has been in charge of all work in the absence of the Entomologist. Mr. Walden has also done most of the photographic work of the department and has helped in inspecting nurseries and imported nursery stock and in carrying out investigations.

Mr. Lowry has also assisted in inspection work and carried on a series of field experiments in controlling the cabbage maggot.

Mr. Davis has been in charge of the field work of controlling the gypsy and brown-tail moths, and when not thus engaged, has assisted in the inspection work.

Mr. Zappe, a graduate of the Connecticut Agricultural College, class of 1912, was employed temporarily during the month of April to inspect imported nursery stock. Since that time he has served as general assistant and has looked after the insectary and collection and breeding records. He also helped inspect the growing stock in the Connecticut nurseries.

Mr. Frank J. Rimoldi, a short course student of the Connecticut College, was employed throughout the winter and during the summer on gypsy and brown-tail moth work. During the inspection season he helped inspect imported and growing nursery stock, but left September 16th, to enter Cornell University for further study.

Miss Valentine has done the stenographic and clerical work of the office, considerable time being required to keep records of the apiary inspection and of the imported nursery stock and attend to the accompanying notices and reports. During her vacation Miss Jessie F. MacMillan was employed as a substitute.

As in the past seasons, Messrs. H. W. Coley of Westport and A. W. Yates of Hartford, have continued to serve as apiary in-

* Beginning April 1st, 1914.

spectors, each receiving *per diem* wages and the necessary traveling expenses.

All the persons mentioned above have labored faithfully to make the work of the department a success and their efforts are not unappreciated.

CHIEF LINES OF WORK.

As in previous seasons, the routine, control and inspection work requires the attention of the members of the staff of the department for most of the time during the year. For instance, all men are engaged in inspecting imported nursery stock for a short time when this stock arrives in greatest abundance. Thus, during October, most of the shipments of *Azalea indica* come into the state. In December and January there are shipments of Rhododendrons, roses, especially Manetti stock, seedling fruit stock, and flowering shrubs for forcing. Some straggling shipments arrive during February, but it is in March and April that the great rush of general nursery stock arrives.

All men of the force are also needed to inspect growing nursery stock the latter part of August and through September.

Mr. Davis has had charge of the scouting for gypsy moth eggs and for brown-tail nests, which is done during the winter months while the trees are bare. Most of the gypsy moth scouting must also be done while the ground is bare, but brown-tail work can be done with snow upon the ground. In severe cold weather or stormy weather scouts cannot work outside. The summer work extends from May until August.

Mr. Lowry has conducted field experiments in controlling the cabbage maggot at the Station farm at Mt. Carmel and on the land of Mr. A. N. Farnham of New Haven. He has also made observations on this and other cabbage insects in these localities and in the fields of other vegetable growers in various parts of the state.

In co-operation with the botanical department the orchard trees at the Station farm have been sprayed each year with various materials and a careful record kept.

Mr. Walden has carried on field tests in attempting to control the white pine weevil in forest plantations, both at the Station experiment forest at Rainbow, and the State forest at Portland. The forestry department has co-operated in this work, and Mr.

Filley, State Forester, and Mr. Walden have made many observations in various plantations in different parts of the State, relating to the weevil and to other insects attacking white pine. These investigations are of such a nature that the work must be continued for a number of years.

The Entomologist, as President of the Anti-Mosquito Committee, Inc., of the Civic Federation of New Haven has had general supervision over the work of the Committee. Mosquitoes were found breeding again in West River, though not as extensively as in 1913, and one oiling was given. All ditches in the salt marshes near New Haven, cut in 1912, were maintained free from obstructions and in working condition in 1914. The Entomologist was also called in as arbitrator in settlement of a disagreement over a mosquito drainage contract in Greenwich, several days being spent in inspecting the work and in preparing a report of findings.

The general studies on insects attacking vegetable crops, and those injuring peach and apple orchards in Connecticut have been continued.

Minor studies, notes and observations have been made on many different kinds of insects, and much work has been done on the collection and in working out life histories in the insectary.

Considerable time was spent in preparing, installing and explaining an exhibit showing the work of this department, which with other departments composed the Station exhibit shown at four agricultural fairs as follows: Salisbury, September 7th; Norfolk, September 10th, 11th and 12th; Brooklyn, September 22nd, 23rd and 24th; Berlin, September 29th, 30th, October 1st and 2nd.

Considerable attention has been given to the preparation of Bulletin No. 22, of the Connecticut Geological and Natural History Survey, "The Hymenoptera of Connecticut," which is now in press.

INSPECTION OF NURSERIES.

The annual inspection of the trees, shrubs and other plants growing in the nurseries of the State, as required by statute, was commenced August 24th, the larger nurseries being inspected first. Messrs. Walden, Lowry, Davis, Zappe, Rimoldi and Britton

all worked inspecting a part of the time, and all worked together in some of the larger nurseries.

During September the services of one man were needed a part of the time to attend to the entomological exhibits at the fairs. Mr. Lowry was delegated for this purpose, and it took his time for nearly three weeks. On account of the war, few shipments of imported Azaleas were expected, but more came than ever before. As these require immediate inspection, their arrival in October somewhat interrupted the other inspection work. Nevertheless it was all finished before November 1st.

As in 1913, the inspection was more thorough than in previous seasons, and all kinds of woody plants were examined, particularly for those pests named in last year's report, page 187. The nurseries, as a whole, were remarkably free from pests, particularly of San José Scale.

A few chestnut trees were found in each of several nurseries, showing the bark disease or blight, and were ordered burned.

In many nurseries no pests could be found. A common infestation is that of Oyster-Shell Scale, which is found on poplar, willow, ash, lilac, etc. San José Scale on fruit trees and currants was present in some of the nurseries. In all cases where trees or shrubs were badly infested with any pest, directions were given that they be destroyed. Where San José Scale was found, in addition to destroying the worst infested trees, all others in the same rows or blocks were ordered fumigated, dipped, or if allowed to remain undug, sprayed.

Besides the regular nursery inspections there are each year a number of cases where persons, not regularly engaged in the nursery business wish to ship small packages of stock. Package certificates are issued for this purpose, after the contents of each package has been duly examined, and apply only to the contents of the package. Most transportation companies now refuse to accept any packages of nursery stock or cuttings unless accompanied by a certificate, and it is against the postal rules and regulations to send any such goods by mail without such a certificate. Persons wishing to obtain certain varieties of apples or other fruit often write to the college at Storrs for scions. In order to have these small parcels properly examined and certificated without undue trouble and expense, Professor G. H. Lamson, Jr., of the college, was appointed a deputy inspector, without salary for this

purpose. Altogether 40 of these packages or parcel certificates were issued during the year.

In the work of inspecting imported nursery stock (chiefly Azaleas) during October, it was found that many florists sell nursery stock and grow small areas of conifers and flowering shrubs for local sale. As this must be regarded as regular nursery stock, a number of such nurseries were inspected this season for the first time. The number of names on the list has increased from 54 to 72. Of the firms on the 1913 list, two have gone out of business, two have changed ownership, and 20 new ones appear in the present list. Six of these are both florists and nurserymen. There has been some increase in the total acreage in Connecticut devoted to the growing of nursery stock, but no careful estimates were secured.

The list of nurserymen for 1914 is as follows:

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1914.

Name of Firm.	Address.	Certificate Issued.	Number of Catalogue.
Barnes Brothers Nursery Co.....	Yalesville.....	Oct. 8,	598
Beattie, Wm. H.....	New Haven.....	Oct. 27,	623
Bowditch, J. H.....	Pomfret Center..	Sept. 10,	583
Brainard Floral and Nursery Co.	Thompsonville...	Sept. 21,	588
Bradley, H. M.....	Derby.....	Nov. 9,	632
Braley & Co., S. A.....	Burnside.....	Sept. 18,	587
Bretschneider, A.....	Danielson.....	Nov. 10,	637
Brooks Bros.....	Westbrook.....	Oct. 8,	601
Burroughs, Thos. E.....	Deep River.....	Oct. 13,	608
Burr & Co., C. R.....	Manchester.....	Sept. 26,	591
Chapman, C. B.....	Groton.....	Oct. 21,	615
Chapman, C. E.....	North Stonington	Oct. 21,	613
Comstock & Lyon.....	Norwalk.....	Nov. 10,	634
Conine Nursery Co., The F. E...	Stratford.....	Oct. 9,	602
Conn Agricultural College (Prof. A. G. Gulley).....	Storrs.....	Nov. 13,	643
Conn. Agr. Experiment Station (W. O. Filley, State Forester)..	New Haven.....	Oct. 21,	616
Conway, W. B.....	New Haven.....	Sept. 9,	582
Cross Highway Nurseries.....	Westport.....	Nov. 10,	636
Dallas, Inc., Alexander.....	Waterbury.....	Nov. 13,	643
Dehn & Bertolf.....	Greenwich.....	Oct. 10,	603
Dowd, Frank C. (2).....	Madison.....	Nov. 10,	635
Elm City Nursery Co.....	New Haven.....	Sept. 10,	584
Fairfield Landscape & Nurseries Co. (2).....	Cannon Station..	Nov. 10,	639

Name of Firm.	Address.	Certificate Issued.	Number of Certificate.
Fuller, H. C.....	New London.....	Dec. 10,	647
Gardner's Nurseries.....	Cromwell.....	Oct. 27,	624
Geduldig, G., Estate of.....	Norwich.....	Oct. 26,	620
Hartford Park Commissioners (G. A. Parker, Supt.).....	Hartford.....	Nov. 6,	631
Hartridge, S.....	Norwich.....	Oct. 24,	618
Heath & Co., H. S.....	Manchester.....	Sept. 29,	593
Holcomb, Irving.....	Granby.....	Oct. 7,	597
Horan & Son, Jas.....	Bridgeport.....	Nov. 9,	633
Houston & Sons, J. R.....	Mansfield.....	Nov. 10,	638
Hoyt's Sons Co., The Stephen...	New Canaan.....	Oct. 12,	605
Hubbard & Co., Paul M.....	Bristol.....	Oct. 15,	610
Hunt & Co., W. W.....	Hartford.....	Oct. 8,	599
Intravaia, Joseph.....	Middletown.....	Oct. 27,	625
Kellner, Herman H.....	Danbury.....	Dec. 30,	648
Kelsey & Sons, David.....	West Hartford...	Nov. 24,	645
Long, J. A.....	East Haven.....	Aug. 29,	581
Mallett-Cockfield & Co.....	Bridgeport.....	Oct. 21,	612
Manchester Nurseries.....	Manchester.....	Sept. 18,	586
McDermott, E. F.....	Windsor.....	Nov. 12,	642
Meier & Gillette.....	West Hartford...	Oct. 13,	607
*Mt. Carmel Forestry & Nursery Co. (H. L. Johnson, Mgr.)....	Etowah, Tenn...	Oct. 26,	619
Munro, Chas.....	New Haven.....	Aug. 29,	580
New Haven Nurseries Co.....	New Haven.....	Aug. 28,	577
New Haven Park Commissioners (G. X. Amrhyh, Supt.).....	New Haven.....	Oct. 5,	595
New London Cemetery Association (F. S. Newcomb, Pres.)...	New London.....	Oct. 21,	614
New London County Nurseries (W. J. Schoonman, Prop.)....	New London.....	Nov. 11,	641
Northeastern Forestry Co.....	Cheshire.....	Sept. 22,	590
Park Gardens.....	Bridgeport.....	Oct. 26,	622
Phelps, J. Wesson.....	Bolton.....	Oct. 28,	627
Phelps & V. T. Hammer Co., The J. W.....	Branford.....	Aug. 28,	578
Pierson, Inc., A. N.....	Cromwell.....	Sept. 30,	594
Platt Co., The Frank S.....	New Haven.....	Nov. 27,	646
Pomeroy, Edwin C.....	Northville.....	Oct. 26,	621
Purinton, C. O.....	Hartford.....	Sept. 21,	589
Reck, Julius.....	Bridgeport.....	Oct. 6,	596
Roehrich, W. G.....	Stratford.....	Oct. 29,	628
Saxe & Floto.....	Waterbury.....	Oct. 30,	630
Schleichert, F. C.....	Bridgeport.....	Oct. 19,	611

* Nursery stock located at Mt. Carmel, Conn.

Name of Firm.	Address.	Certificate Issued.	Number of Certificate.
Scott, J. W.....	Hartford.....	Nov. 11,	640
Seavey, Wallace.....	New Haven.....	Aug. 29,	579
Sierman, C. H.....	Hartford.....	Oct. 22,	617
South Wilton Nurseries.....	South Wilton....	Oct. 10,	604
Steck, Chas. A.....	Bethel.....	Oct. 29,	629
Streckfus, H. P.....	Litchfield.....	Sept. 14,	585
Turner & Co., Chas.....	Hartford.....	Sept. 29,	592
Vidbourne & Co., J.....	Hartford.....	Oct. 13,	606 _{as}
Woodruff, C. V.....	Orange.....	Oct. 14,	609
Yale University Forest School...	New Haven.....	Nov. 14,	644
Young, Mrs. Nellie A.....	Pine Orchard....	Oct. 8,	600

INSPECTION OF IMPORTED NURSERY STOCK.

By W. E. BRITTON AND B. H. WALDEN.

There has been no decrease in the shipments of nursery stock into Connecticut from foreign countries since the rules and regulations of the Federal Horticultural Board became operative two years ago. On the other hand, these shipments increase each year, and were it not for the system of notices and permits established by the Board it would be difficult to trace many of them. As it is, we are able to follow up and inspect most of them. All woody field-grown plants are supposed to be inspected whether consigned to nurserymen, florists, or private owners.

The regulations of the Federal Horticultural Board require that the importer, who is usually the broker, shall send a notice of each shipment to the state nursery inspector of the state to which the shipment is consigned. The Federal Horticultural Board issues a permit before the stock can enter the United States, and this Board also sends to each state inspector a notice, in duplicate, of each shipment consigned to that state. Both copies are to be filled out after the stock has been inspected; one is returned to the Federal Horticultural Board and the other kept on file as a record in the state inspector's office.

On receipt of the first notice of each shipment a post card containing the following, is sent from this office to the consignee or importer:

OFFICE OF STATE ENTOMOLOGIST.

Agricultural Experiment Station, New Haven, Conn.

DEAR SIR:—This office has just received notice from.....

.....
 regarding.....case or package of imported nursery stock consigned to you. Under the Federal Horticultural Law, we shall try to inspect all woody plants imported into Connecticut.

Please notify this office as soon as the stock arrives at your grounds (but not before) and we will try to inspect it promptly. It is illegal for you to unpack it until the inspector arrives, unless permission is granted from this office.

Very truly yours,

W. E. BRITTON,

State Entomologist.

During the year ending September 30, 1914, 303 separate shipments of imported nursery stock have been inspected by this department. These shipments contained 1,477 boxes and packages and 1,646,130 plants. Of 32 other cases in 10 shipments at first reported, two were not received, ten were reshipped without unpacking; one was damaged on reaching New York and was replaced by New York grown stock; one was a box of seeds; one contained carnations; nine contained herbaceous stock; two were greenhouse grown; three were inspected by Federal authorities; and three small shipments were unpacked and distributed before they could be traced. These shipments, therefore, were not inspected. This stock came from the following countries:

<i>Country.</i>	<i>No. Shipments.</i>	<i>No. Cases.</i>
Holland.....	123	771
Belgium.....	96	450
France.....	29	127
England.....	24	65
Ireland.....	10	17
Germany.....	8	8
Scotland.....	6	16
Japan.....	3	19
Italy.....	2	2
Hungary.....	1	1
Locality not given.....	1	1
Total.....	303	1,477

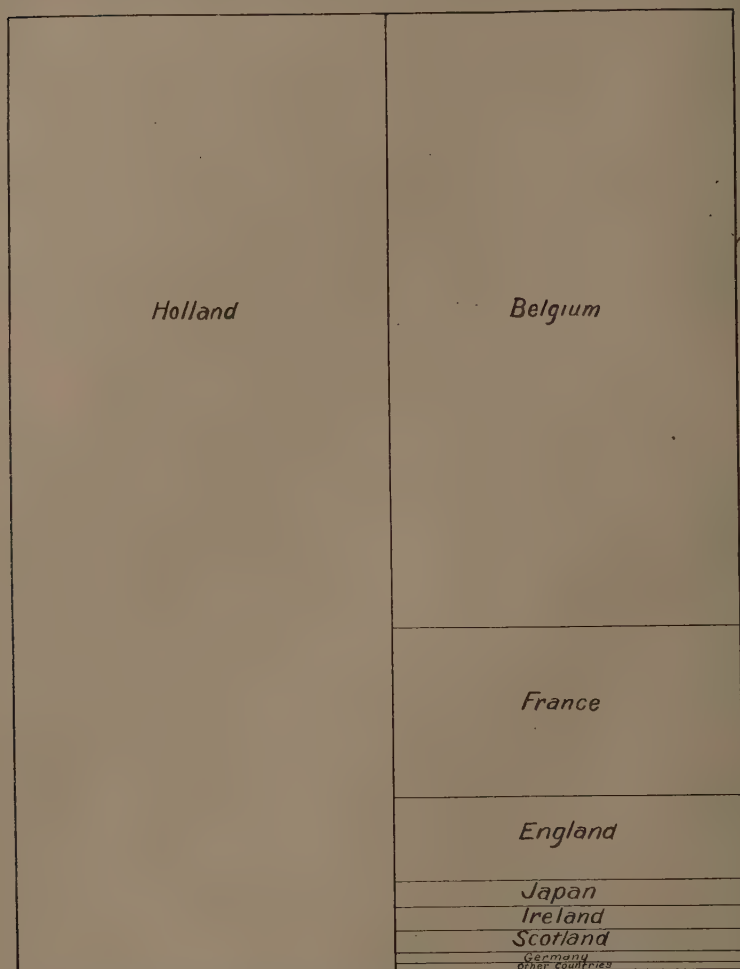


FIG. 1. Diagram showing proportional amounts of nursery stock grown in the different foreign countries sending stock into Connecticut.

In the inspection of this imported nursery stock, in 1914, insects and plant diseases were found in 58 shipments as follows:

PESTS FOUND.

Crown gall, *Bacterium tumifaciens* Smith & Towns. (6 shipments)

On Manetti rose stock.

James Palmer & Son, Ltd., Annan, Scotland. King Acre Nurseries, Hereford; Walter S. Slocock, Woking, Surrey; R. H. Bath, Wisbech; Stuart Low & Co., Enfield, England.

Black Fungus. Apparently *Sclerotinia Fuckiana* DeBy. (Fckl.) Sclerotial stage. (1 shipment)

On grape cuttings. (Shipper unknown) Hungary.

Fungus (unidentified) on Rhododendron leaves. (1 Shipment)
A. Ouwerkerk, Boskoop, Holland.

Fungus, *Exobasidium* on *Azalea indica*. (18 shipments)

O. & Th. de Raeve Freres, K. J. Kuyk, C. Petrick, Arthur De Meyer, Ghent; August Haerens, Somergem; Bier & Ankersmit, Melle, Belgium.

Fungus, *Graphiola Phoenixis* Moug. (Poit.) (1 shipment)

On Phoenix palm. K. J. Kuyk, Ghent, Belgium.

White Fly. *Aleyrodes* (undescribed) on *Azalea indica*. (7 shipments.) K. J. Kuyk, C. Petrick, Ghent, Belgium.

Soft Scale, *Coccus hesperidum* Linn. (6 shipments)

On bay trees. Arthur DeMeyer, K. J. Kuyk, Ghent, Belgium.

Hemispherical Scale, *Saissetia hemisphericum* Targ. (1 shipment)

On palms. K. J. Kuyk, Ghent, Belgium.

Mealy bug. *Coccus* sp. (2 shipments)

On *Araucaria*. Bier & Ankersmit. On rubber plant, De Coster Bros., Melle, Belgium.

Oyster-shell Scale, *Lepidosaphes ulmi* Linn. (6 shipments)

On Box, *Buxus*. H. den Ouden & Son, Koster & Co., Van Kleef Bros., Schaum & Van Tol., H. M. Hardyzer, Boskoop, Holland.

Chionaspine Scale in egg stage, probably *Hemichionaspis aspidistræ* Sign. (1 shipment)

On *Aspidistra*. P. & L. Vander Sypt, Loochristy, Belgium.

Diaspine Scale, *Chrysomphalus* sp. (1 shipment)

On bay tree. Arthur DeMeyer, Ghent, Belgium.

Mites. Probably common red spider. (3 shipments)

On Kentia palm. Arthur DeMeyer, Ghent, Belgium.

On Box, *Buxus*. W. C. Hage & Co., Boskoop, Holland.

On *Rhododendron*. Ebbinge & Van Gross, Boskoop, Holland.

Spring-tails—Collembola. (1 shipment)

On roses. P. Loef Az, Boskoop, Holland.

Aphids (immature) (1 shipment)

On *Viburnum*. Van den Willik & Koetner, Hazerswoude, Holland.

Work of borer in ash. (1 shipment)

F. J. G. Van der Bom, Oudenbosch, Holland.

Rusty Tussock Moth, *Notolophus antiqua* Linn. Eggs. (1 shipment)

On *Spiraea*. Kallen & Lunneman, Boskoop, Holland

Lepidopterous cocoons. (3 shipments)

On Manetti rose stock. Vincent Le Breton's Nurseries, Angers, France. F. L. Van Leeuwen & Son, Sassenheim, Holland.

Noctuid Larva. (1 shipment)

On *Retinospora*. G. W. Van Gelderen, Boskoop, Holland.

Pierid Larva. (1 shipment)

On *Azalea indica*. K. J. Kuyk, Ghent, Belgium.

Lepidopterous eggs (unidentified) (2 shipments)

Probably Tortricid egg-mass. On *Azalea indica*. L. Van Leeuwen & Son, Meirelbecke, Sassenheim, Holland. On *Rhododendron*, Boskoop, Holland.

INSPECTION OF APIARIES.

The inspections made in 1914 represent the first season's work under the new law passed by the General Assembly of 1913, which provides for quarantines, for inspection without complaints, and an appropriation of \$750.00 annually, which is more than double the amount available in previous years. So far the new law seems to be satisfactory. On account of the increased appropriation much more area was covered and many more apiaries inspected than ever before.

As during the preceding four years, Messrs. H. W. Coley of Westport and A. W. Yates of Hartford, have served as inspectors, receiving wages for the time actually engaged in the work. Mr. Coley has jurisdiction over the four counties, Fairfield, New Haven, Middlesex and New London, in the southern part of the state, while Mr. Yates has the northern counties, Litchfield, Hartford, Tolland and Windham.

This year, for the first time, some American Foul Brood was found in the State in the towns of Bethlehem and Old Lyme (Blackhall).

In the inspection work the State was quite thoroughly covered, as may be seen from the following table, which gives the number of apiaries and colonies inspected in each town where work was done, and the number of each found diseased:

APIARIES INSPECTED, 1914.

Arranged by Towns.

Town.	No. Apiaries			No. Colonies	
	Inspected.	Diseased.	Quarantined.	Inspected.	Diseased.
FAIRFIELD COUNTY					
Bethel.....	4	1	1	10	2
Bridgeport.....	2	1	0	44	9
Danbury.....	3	0	0	51	0
Darien.....	2	1	1	66	1
Fairfield.....	13	5	4	260	8
New Canaan.....	6	4	4	59	20
Norwalk.....	2	0	0	5	0
Ridgefield.....	7	5	5	34	6
Stamford.....	6	2	2	72	12
Stratford.....	2	0	0	71	0
Westport.....	2	1	1	28	12
Wilton.....	16	5	4	94	6
Total.....	65	25	22	794	76
NEW HAVEN COUNTY					
Beacon Falls.....	5	2	2	45	27
Cheshire.....	3	0	0	43	0
Derby.....	3	0	0	40	0
Hamden.....	2	2	1	24	4
Madison.....	1	0	0	22	0
Middlebury.....	5	0	0	41	0
Milford.....	7	4	1	39	31
Naugatuck.....	3	0	0	21	0
Prospect.....	8	0	0	57	0
Seymour.....	1	1	1	8	1
Waterbury.....	2	1	0	51	1
Total.....	40	10	5	391	64
MIDDLESEX COUNTY					
Chatham.....	15	8	7	117	27
East Haddam.....	14	7	7	97	23
Haddam.....	6	6	6	31	26
Total.....	35	21	20	245	76

Town.	No. Apiaries			No. Colonies	
	Inspected.	Diseased.	Quarantined.	Inspected.	Diseased.
NEW LONDON COUNTY					
Colchester.....	2	2	2	29	25
Lisbon.....	3	3	2	82	18
Montville.....	8	2	1	47	9
New London.....	3	2	0	25	6
Norwich.....	5	4	3	97	24
Old Lyme.....	6	4*	4	30	26
Waterford.....	2	0	0	46	0
Total.....	29	17	12	356	108
LITCHFIELD COUNTY					
Bethlehem.....	1*	1	1	3	1
Goshen.....	2	0	0	15	0
Harwinton.....	1	1	0	6	6
Plymouth.....	8	4	0	63	7
Sharon.....	1	0	0	3	0
Thomaston.....	11	6	0	44	24
Torrington.....	14	6	1	124	28
Watertown.....	12	4	0	119	10
Winchester.....	21	5	1	83	10
Woodbury.....	5	0	0	44	0
Total.....	76	27	3	504	86
HARTFORD COUNTY					
Berlin.....	18	4	0	67	11
Bloomfield.....	3	0	0	24	0
Bristol.....	13	5	0	75	13
Burlington.....	9	2	0	37	5
East Granby.....	7	4	0	41	5
East Hartford.....	3	2	1	17	3
East Windsor.....	9	2	0	102	8
Enfield.....	10	4	0	59	17
Farmington.....	12	2	0	62	3
Glastonbury.....	11	1	0	33	1
Granby.....	7	1	0	70	7
Hartford.....	10	1	0	34	7
Manchester.....	9	2	0	45	3
New Britain.....	14	5	0	91	8
Newington.....	2	0	0	42	0
Plainville.....	7	3	1	65	9
Rocky Hill.....	4	1	0	17	2
Southington.....	5	3	0	51	13
South Windsor.....	6	2	1	27	2
Suffield.....	5	3	0	42	4

*American Foul Brood.

Town.	Inspected.	No. Apiaries		No. Colonies	
		Diseased.	Quarantined.	Inspected.	Diseased.
HARTFORD COUNTY—Continued.					
West Hartford.....	5	3	0	101	4
Wethersfield.....	5	0	0	40	0
Windsor.....	3	0	0	43	0
Windsor Locks.....	2	0	0	47	0
Total.....	179	50	3	1232	125

TOLLAND COUNTY

Bolton.....	2	0	0	7	0
Coventry.....	2	0	0	5	0
Somers.....	2	0	0	26	0
Stafford.....	6	3	0	82	22
Vernon.....	12	10	0	164	29
Willington.....	1	0	0	7	0
Total.....	25	13	0	291	51

WINDHAM COUNTY

Brooklyn.....	2	1	0	13	1
Canterbury.....	2	0	0	8	0
Hampton.....	2	0	0	7	0
Pomfret.....	8	4	0	41	11
Total.....	14	5	0	69	12

SUMMARY OF APIARY INSPECTION.

	Apiaries.	Colonies.
Number inspected	463	3,882
Infested, European foul brood.....	151	543
Per cent. infested.....	32.6	13.9
Infested, American foul brood.....	5	27
Per cent. infested.....	1.07	.7
Sac or Pickled brood.....	12	28
Average number of colonies per apiary..		8.38
Cost of inspection.....		\$749.76
Average cost per apiary.....	\$1.62	
Average cost per colony.....	.19	

GYPSY MOTH CONTROL WORK IN 1914.

BY W. E. BRITTON AND IRVING W. DAVIS.

Since 1906 the gypsy moth has been known to be present in Stonington, and in December, 1909, was discovered in Wallingford. Previous reports of this station describes the vigorous measures which have been taken to exterminate the pest in each of these infestations. We now believe that the gypsy moth was actually exterminated in each locality, but that a reinfestation due

to wind spread of the newly-hatched caterpillars in 1913 occurred at Stonington, and at the same time infested nearly the whole eastern end of Connecticut. Outside of the area previously infested at Stonington the new infestations were discovered by Federal scouts, after learning of the caterpillars found by the state men on the banded trees near Stonington village. Most of the control work outside of Stonington and Wallingford has been also done by Federal men, to whom Connecticut is greatly indebted for help at the time when state funds were entirely inadequate to cope with the situation. The following pages describe the work in detail:

WALLINGFORD.

Here the colony was steadily reduced under the careful work of Mr. Caffrey, and in 1913 only three caterpillars were taken. Nevertheless, work was continued. The State scouts commenced work on December 22nd and made a careful examination of the area banded in 1913, bounded by the New York, New Haven and Hartford Railroad tracks on the west, Ward Street on the south, Fair and Main Streets on the east and Center and Church Streets on the north. Special attention was given to the district near Orchard street, where caterpillars were last found. No egg-clusters were found and the scouting was finished January 10th.

Outside of the area mentioned above, the entire town was searched by Federal scouts without finding any egg-clusters. Nevertheless, the trees in the central area were banded as in 1913, and three men, Messrs. C. W. Bolton, R. H. Hillbom and O. C. Malmquist, in charge of Mr. Bolton, were employed by this department to turn the bands and to search for caterpillars from May 18 to August 8. None were found.

The figures showing the results of the work in the Wallingford infestation, not including the caterpillars killed by spraying, or those caught in the tanglefoot bands, are given below:

SUMMARY OF WORK AT WALLINGFORD.

	1910	1911	1912	1913	1914
Egg-masses destroyed.....	8,234	23	5	2	0
Cocoons destroyed.....	95	15	1	0	0
Caterpillars destroyed at burlap bands..	8,936	1,551	26	3	0
Trees banded with burlap.....	10,000	8,556	5,379	2,135	2,135
Trees banded with tanglefoot.....	365	469	128	128	128
Trees sprayed with poison.....	219	116	11	0	0
Trees pruned.....	904	33	0	0	0
Cavities filled with cement.....	27	0	0	0	0
Cavities covered with tin patches.....	1,959	100	0	0	0

STONINGTON.

Winter Scouting.

During the summer of 1913 several gypsy moth caterpillars were captured on the Stanton estate and at one or two other places within the area formerly infested, but where nothing had been found since 1911. It was, therefore, imperative that the entire area of the old infestation be scouted during the winter, and accordingly scouts were sent to Stonington on December 2, remaining there until December 19th.

The area contained in the old infestation, which consisted of the borough of Stonington and north to the road leading to Elihu's Island on the east, thence westerly to the southern boundary of the cemetery, was all scouted. Particular attention was given to the grounds around the Stanton place and to the other localities where caterpillars were taken the previous summer. Scouting was also done outside of this section already mentioned, at Stonington Manor and on Elihu's Island. At the former place, where many automobiles from the infested district stop during the course of the summer, the trees and bushes were examined as it was thought that the caterpillars might possibly have been introduced through that medium.

Trees on the farm of Mr. West, who resides about $1\frac{1}{2}$ miles north of Stonington, were also examined. Mr. West has the hay from the Stanton estate, and as this has been the center of infestation, it was deemed best to scout around this farm since there was a possibility that a colony might have become established in that section. No egg-masses were found.

Outside of the area examined by the state scouts and mentioned above, Federal scouts examined the remaining area in the town of Stonington, and also the towns of Groton, North Stonington and many other towns in the eastern end of the State, as is mentioned on page 133. In Stonington seven infestations were found, all outside of and north of the area previously infested where state men had worked. One was found just west of the river at Mystic, this being in the town of Groton.

SUMMER WORK.

Two of the infestations mentioned above were near Westerly, R. I., and were taken care of by the Federal men. All others in

Stonington and that in Groton were looked after by state men. The other five Stonington infestations were located as follows: One in the oak woods back of Stonington Manor Inn, on the land owned by Mr. E. P. Edwards. One in an old apple orchard on what is commonly known as the Gallup place and now occupied by Mrs. Schrorer. The third infestation was in the orchard of Mr. Davis, who lives on an old "pent road" about one-half mile south of the North Stonington town line. The two remaining infestations were on opposite sides of the road in what is known as the Anguilla district and on land owned by Mr. York.

In the town of Groton there was but one infestation and that on Pearl Street, Mystic, on land owned by Mr. Edgecomb.

The work commenced on April 29th and closed August 8th. During this time seven men, including Mr. F. J. Rimoldi, John L. Wright, Stanley M. Prouty, George W. Smith, Paul McDermott and F. Hoadley, with Mr. Davis in charge, were engaged in the work, but the average number employed was four.

The first week was spent in banding trees in the various infested areas, in cutting brush and thinning out the nearby trees.

The number of tanglefoot bands applied was as follows:

Gallup Place	10
Manor	82
Mystic	4
Anguilla (right)	13
Anguilla (left)	13
Davis	8

130

In addition to the above, at the Manor infestation burlap was also used, while within the limits of the old infestation seventy-one tanglefoot and one hundred and thirty-eight burlap bands were applied.

All of the bands were examined daily until the middle of June, and from then on until the work closed they were examined every other day.

Wherever possible various sections of woodland were scouted, and although the most of this work was done in Stonington, at various times the work was carried into the edges of both Groton and North Stonington.

The work closed on August 8th without any gypsy moth caterpillars or new infestations having been found.

WORK DONE BY FEDERAL SCOUTS.

Men employed by the Federal Bureau of Entomology scouted the open area in two tiers of towns across the eastern end of the State during the winter. They found a large number of small infestations one or two egg-clusters in a place, scattered over ten towns. The summer work in these towns, except in Stonington and Groton, as previously noted, was also done by Federal men. The egg-clusters were creosoted when found, their location indicated on maps, and significant guiding marks were placed on trees or fences at the nearest point along the highway, to enable one to reach the spot without unnecessary searching. In general, the trees were banded over a circular area extending, perhaps, 100 feet from the egg-cluster, in order to catch the caterpillars hatching from scattered eggs. A number of caterpillars were found on the bands. Later scouts were sent into the woodland areas and many more small and scattered infestations were found. The infestations in both open country and woodland were thickest in the northeast corner of the State, the town of Thompson leading in number.

Altogether the Bureau of Entomology expended \$17,555.66 in scouting and other work in Connecticut, in 1914, previous to September 15. Colonies of *Calosoma* beetles and their larvæ, which feed upon gypsy caterpillars, were planted in Stonington and in Thompson by the Federal men. We wish to acknowledge the cordial help and co-operation which Connecticut has received from Mr. A. F. Burgess, Mr. L. H. Worthley and their associates of the Bureau of Entomology, who are engaged in this work.

PRESENT INFESTED AREA.

Thus the ten towns of Thompson, Woodstock, Putnam, Pomfret, Killingly, Brooklyn, Voluntown, North Stonington, Stonington and Groton must now be considered as infested with gypsy moths, though the pest is not yet abundant in any of them. Consequently these towns were quarantined August 1st, 1914, by the

Federal Horticultural Board. The location of these towns and the quarantine lines are shown in figure 2.

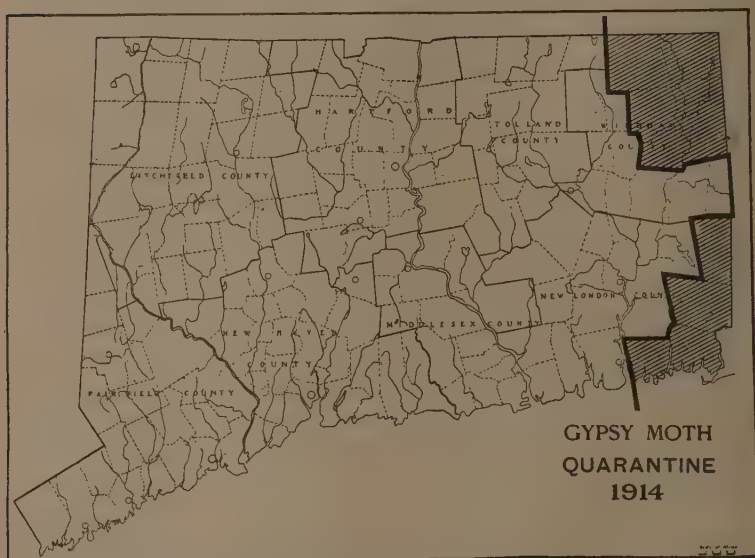


FIG. 2. Map of Connecticut showing area quarantined on account of gypsy moth.

FUTURE NEEDS AND PROSPECTS.

As the present infestation in Connecticut is on the edge of the large gypsy moth area covering Rhode Island, eastern Massachusetts, southeastern New Hampshire and southwestern Maine, it is evident that it cannot be easily exterminated, as might be the case with a separate colony, and as has been done at Wallingford and at Stonington. The methods of control to be adopted in future work must be quite different from those employed in extermination work in the past. Much scouting must be done each year, and this with the use of tanglefoot bands around the infestations will serve to hold the pests from gaining a firm foothold, and from spreading across the State. This means constant, careful work. The Federal force will aid us, but cannot assume the whole burden. In order to properly cope with the situation the State must appropriate a larger amount for this work.

SUPPRESSION WORK AGAINST THE BROWN-TAIL MOTH IN 1914.

BY W. E. BRITTON AND IRVING W. DAVIS.

Scouting to determine the extent of spread and the abundance of the brown-tail moth in 1913 was commenced January 15, 1914. The force of scouts in charge of Mr. Davis consisted also of Messrs. F. J. Rimoldi, John H. Osgood, E. R. Sherman, John L. Wright, A. J. Bibeault, J. S. Shepard and George Capwell.

By comparing the following pages with last year's report (page 204) it will be seen that while the pest has spread westward and several new towns were found infested, the nests were much fewer in the old infestations than in 1913. Mr. Davis' notes follow:

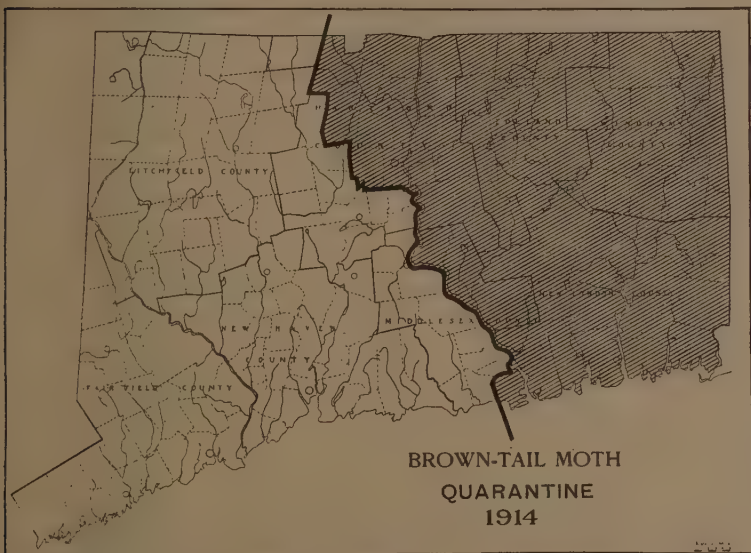


FIG. 3. Map of Connecticut showing area quarantined on account of brown-tail moth.

Owing to the spread of the brown-tail moths during the last two years it became impracticable to scout the entire section of the State infested. Accordingly the work done this year consisted of scouting the towns just east of the Government quarantine line and the towns to the westward until no moths were found. East of the quarantine line the scouting consisted of a strip approximately one town in width. In the northern part of the State,

however, beginning with Hartford and West Hartford and extending to the Massachusetts line, two towns within the quarantine line were covered. All towns west of the Connecticut river and within the quarantined area were scouted, and from East Hartford to Stonington a strip one town in width east of the quarantine line was worked.

Outside of this district the towns scouted varied with the nests found in each section. All of the towns from the quarantine line to the Connecticut river were covered, as was Old Saybrook. The Federal scouts reported a nest in Old Saybrook, but since they had scouted westward without finding anything, no further work was done in that immediate vicinity. Northward, where the line crosses to the west side of the river, from one to two towns westward were scouted, with the addition that various railroad junctions, as Middletown, New Britain and Berlin Junction, were given extra attention. The work closed on April 11th, with the following towns having been found infested for the first time.

Granby, Simsbury, Lebanon, Colchester, Salem, Ledyard, Montville, Groton, Waterford, New London, East Lyme, Old Lyme and Old Saybrook. These towns and all other towns east of the Connecticut River were included in the quarantine extension made effective August 1st, and shown on the map, figure 3.

Extra scouting was also done in the northeastern part of the State in the towns of Thompson, Putnam, Woodstock and Pomfret.

Details of the scouting may be found in the following pages:

HARTFORD COUNTY:

Suffield—23 nests.

In scouting Suffield during 1913 a rather large infestation (565 nests) was discovered. This year, however, although all of the roads within the town limits were scouted, only 23 nests were found. Nineteen of these were on the West Suffield road near Suffield Center. The remainder, 4 in number, were scattered along the northern section of the town near the Massachusetts line.

Granby—1 nest.

All of the roads in Granby were scouted and resulted in the finding of a single nest on the main road between Granby Center

and North Granby, very near the latter village. It might also be well to note that the nest was within a mile of the Southwick (Mass.) line.

Simsbury—4 nests.

The entire town, which includes the villages of Simsbury, West Simsbury, Tariffville and Weatogue, was scouted and four nests were found on two roadside trees standing on land owned by William Kelly on the Firetown Road, about two miles northwest of the village of Simsbury.

West Hartford—I nest.

West Hartford was one of the towns found infested last year, and although all of the town was scouted again this year, the only nest found was at 1014 Farmington Avenue, a short distance west of the post office in West Hartford.

Hartford—94 nests.

It was the intention to scout the entire city of Hartford, but after working a few days in that section it was learned that Federal scouts had covered part of the city. The State men, therefore, confined their efforts to the remaining section and found 94 nests. As was the case last year, the most of the nests were found near the large infestation around John and Main Streets. Three isolated cases, one on Windsor Avenue near the Windsor town line, one at 48 Imlay Street, and the third at 3 Queen Street, concludes the list.

East Hartford—48 nests.

Forty-eight nests were found as the result of scouting the entire town of East Hartford. These were in the village of East Hartford very near the Connecticut river.

Of the remaining towns in Hartford County, which were scouted all of the roads in East Granby, Windsor Locks, Windsor, Bloomfield, Avon, Farmington, Newington, Wethersfield and Glastonbury, were covered but no nests were found.

The following towns were partially scouted:

Hartland—A few of the roads in the eastern part of the town.

Canton—The village itself and main roads adjacent to it.

Plainville—The center and road leading to New Britain.

New Britain—The central portion of the city and streets along the various railroads.

Berlin—Around the railroad station, and roads in that vicinity.

Rocky Hill—The village and main roads.

Marlboro—The principal roads.

Manchester—Covered by Federal scouts, so only partially scouted by State men.

TOLLAND COUNTY:

Mansfield—2 nests.

Only two nests were found as the result of scouting all of the roads in this town. One of these was found on the South Coventry road near the town line, while the other was in the southwest corner of the town.

Columbia—1 nest.

All of the roads in Coventry, Hebron, Bolton and Andover were scouted but no nests were found.

WINDHAM COUNTY:

Windham—7 nests.

This town, which includes the city of Willimantic, was thoroughly scouted and seven scattered nests found, only one of which was in the city. Three nests were taken in the north part of the town and two near the Franklin line on the farm of Mr. Chamberlain. The remaining nest was found near the Poor Farm.

Putnam, Thompson, Woodstock, and Pomfret, which have been found badly infested the last two years, were not scouted this winter. One man, however, visited the sections which were badly infested last year and estimated the number of nests to be about 15 per cent. of the number found in 1913.

NEW LONDON COUNTY:

Franklin—5 nests.

The roads in this town were all scouted, and although no nests were found here a year ago, five were cut there this season. Three of these were taken near the Windham line, in the north part of the town. At Franklin Station one was found, and the fifth came from the southern part near the Norwich line.

Lebanon—13 nests.

In scouting Lebanon all of the roads were covered and 13 nests cut. Near Lebanon Station, which is very near the Franklin line, 8 nests were found, three of them being about one-half mile south of the Station on the farm of Mrs. E. J. Warner. The others were also found in the same section of the town but nearer the Bozrah line, one being within a mile of Bozrahville.

Sprague—2 nests.

Only the western roads of this town were scouted and two nests were found.

Bozrah—3 nests.

The villages of Fitchville, Bozrah Street and Bozrahville and all connecting roads were scouted with the result that three nests were found. Two of these were in Bozrah Street and the third was found in the southern part of the town near the Montville line.

Norwich—169 nests.

In 1913 only two nests were found in the town of Norwich, both being within the city limits. This year in scouting the entire town a marked increase was noted, 169 nests being found. The city of Norwich contained the most of them, 115 nests being cut within the city limits. The remaining nests were near the various villages, of which there are several in the town. In Greenville and vicinity 22 nests were found, while at Occum 18 were taken and 10 more in and about Norwich town. The last four were cut in Taftville.

Colchester—2 nests.

All the territory within the limits of this town was scouted and two nests were found. These were widely separated, one being in the northwestern section of the town and the other in the southern part near the Salem line.

Salem—I nest.

Only one nest was found as a result of scouting all of the roads in Salem. This nest was found at Salem Street about one-half mile north of the church.

Montville—9 nests.

The entire town of Montville, which includes the villages of Chesterfield, Uncasville, Montville, Fair Oaks, Massapeag and Mohegan, was scouted. Two nests were found in the village of Massapeag and two more in the village of Montville. Single nests were taken at Uncasville, Raymond Hill, Fair Oaks and on the Salem Road. The road south toward Waterford yielded two more, making a total of nine nests found in the town of Montville.

Waterford—168 nests.

This was one of the few coast towns in which anything resembling a colony of brown-tail moths was found. Near Durfy Hill in the southwestern part of the town 156 nests were cut on three adjoining farms. Twelve other scattering nests were found in this town, two on Millstone Point and 6 on the turnpike leading to New London. In the central portion of Waterford no nests were found, but in the eastern part, on the road leading to Montville four more were taken, making a total of 168 nests for Waterford.

New London—34 nests.

All of the territory in this city was scouted and resulted in finding 34 nests. Here again the nests were so well distributed that no one locality can be mentioned as having a bad infestation. If any section contained fewer nests than another it was that in the vicinity of Ocean Beach, but this can be explained by the lack of fruit trees in that section.

Ledyard—14 nests.

Fourteen scattered nests were the result of scouting the entire town of Ledyard. In the southeastern part of the town six nests were taken along the Norwich road. At Ledyard Center two nests were found and three more on the road leading north from this point. The three other nests were found along the road which leads to North Stonington.

Groton—103 nests.

In this town a very large percentage of the nests taken were found along the coast and in the valley of the Mystic River. This section also contains the greater part of the population, for it in-

cludes the villages of Mystic, Old Mystic, Noank, Poquonoc Bridge and Groton. Ninety-one of the 103 in Groton were found in these villages and along connecting roads. The remaining 12 were scattered through the central portion of the town, six being a little west of Burnett's corners, two at Center Groton, and four on the main road between Groton and Center Groton.

Stonington—50 nests.

The brown-tail work done in this town was in connection with the gypsy moth scouting, and the 50 nests found were, therefore, in the southern part of the town near the borough of Stonington. A small colony of twenty nests was taken from a few pear trees at Dr. Thurber's on Water Street, but the others were widely separated.

East Lyme—13 nests.

Flanders Village, Niantic, East Lyme and all of the main roads in this town were scouted and 13 nests were found, all of them south of the Shore Line trolley tracks. Two were found in the village of Niantic and six on the road north from there to Flanders Village. The other four were found, two each on Black Point and along the turnpike near Flanders.

Old Lyme—64 nests.

All of the roads in this town were scouted and 64 nests were found near the village of Blackhall. A colony of 58 nests was found on the farm of Mr. John DeWolf about one-half mile south of the Lyme and Blackhall station. The other six nests were taken from neighboring farms.

Lyme.

The southern roads of this town, including the village of Hamburg and vicinity, were scouted but no nests were found.

MIDDLESEX COUNTY:

Old Saybrook—I nest.

The entire town of Old Saybrook was scouted but no nests were found, although the Federal scouts found one on College Street.

East Haddam, including the various villages and principal roads were scouted. The main roads in Portland and Chatham and a few of the roads in Cromwell were also covered. In Middletown the central portion of the city and streets along the various railroad lines were covered, but in none of these towns were any nests found.

NESTS TAKEN DURING 1914

HARTFORD COUNTY.		NEW LONDON COUNTY.	
Granby.....	1	Lebanon.....	12
Simsbury.....	4	Franklin.....	5
Suffield.....	23	Sprague.....	2
W. Hartford.....	1	Colchester.....	2
E. Hartford.....	48	Bozrah.....	3
Hartford.....	94	Norwich.....	169
		Salem.....	1
TOLLAND COUNTY.		Montville.....	9
Mansfield.....	2	Ledyard.....	14
Columbia.....	1	Groton.....	103
		Waterford.....	168
WINDHAM COUNTY.		New London.....	34
Windham.....	7	East Lyme.....	13
		Stonington.....	50
MIDDLESEX COUNTY.		Old Lyme.....	64
Old Saybrook... (reported)....	1	Total.....	831

THE CABBAGE ROOT MAGGOT.

Phorbia brassicæ Bouché.

Order Diptera: Family Anthomyiidae.

By QUINCY S. LOWRY.

Growers of cabbages, cauliflowers and allied plants are more or less bothered by the cabbage root maggot, which feeds on the roots of plants belonging to the Cruciferae or Mustard family, causing serious damage to those which are cultivated as crops.

DISTRIBUTION.

This pest, like several others of the most serious pests of this country, was introduced from Europe some seventy-odd years ago, and was first studied in this country by Dr. Harris, in 1835. It made its first appearance in Massachusetts, and has gradually spread, until now it is undoubtedly injurious in every state where

its food plants are grown. It has been recognized as a serious pest in Europe, since the early part of the nineteenth century, especially in England and Germany. Already it has been reported from nearly every state in the United States, and as early as 1885 Fletcher reported it as destroying from 25% to 75% of the cauliflowers in Canada.

LIFE HISTORY.

(a) The egg of the cabbage maggot is about $1/25$ of an inch in length (plate XII, a, twice enlarged) slightly curved in outline, somewhat pointed at the ends, and is white or yellowish white in color. These eggs are deposited on or just below the surface of the ground, near the stem of the plant; each female is capable of laying from 50 to 60 eggs. As the ovipositor of the female is soft, it is not capable of puncturing the tissues of the food plant and is forced to deposit the eggs on the ground. If the female can find a crevice near the stem of the plant she will crawl just beneath the surface of the ground and deposit her eggs as closely as possible to the stem of the plant. The egg is quite delicate, and, therefore, must be laid where it will receive no injury, and as the young maggot is helpless it will perish unless the egg is close to the plant, which supplies its food. If the eggs are laid on the surface of the ground and allowed to stay in the sun, they will soon dry up. The period of the egg-stage varies, from four to ten days. In this locality the eggs are generally found from May 1st to 15th, according to weather conditions. This year the first eggs were collected May 18th, this being a late spring, having frost enough on May 1st and 2nd to injure some of the larger leaves of the young cabbage plants. Most of the eggs found at this time (May 18th) were just beneath the soil near the stem of the plant—two eggs were found attached to the base of a leaf which had been covered with soil. (See plate XII, a.)

(b) The (larva) maggot is white or yellowish in color, cylindrical in outline, and is always footless. The posterior end bears two spiracles and is surrounded by twelve conical tubercles, the middle two being slightly cleft. The anterior (pointed) end bears the mouth opening, which is surrounded by fleshy lip-like prominences and contains two dark hook-like structures. These are connected interiorly with a chitinous framework which serves for muscular attachment. This is the only means the maggot has to

secure its food. Although it cannot bite, it is, however, capable of scraping the soft tissue of the plant, breaking up the plant cells. Following this injury decay immediately sets in, causing a further softening of the plant tissue and making it easier for the maggots to penetrate. On each side of the body, just back of the head, is a dark spot, which consists of ten fan-like lobes.

The maggot reaches its growth in from three to four weeks, and then is slightly over one-quarter of an inch long. In 1914, the first maggots were found and brought to the laboratory on May 22nd.

Sometimes cabbage plants become infested in the seed-bed, and, therefore, all plants should be examined before setting in the field. While setting some plants at the Experiment Station Farm at Mt. Carmel, June 6th, several plants were found thus infested. All seed-beds should be examined carefully before the plants are set, thus preventing what would result in a great loss to the crop.

(c) When the maggot is full grown it generally leaves its food plant (very often it is found in the galleries it has made in the stem) going into the earth for an inch or so away from the root of the plant upon which it has been feeding. It is unlike most insects, in that it does not separate from its own skin when it pupates, but uses it as a protection while changing to the so-called pupa. It is of a brownish color, varying from light to dark brown, and elliptical ovate in form. In Connecticut these pupæ can usually be found about the middle of June. This year the first pupæ were collected June 8th. The pupæ are about one-fourth of an inch in length or a trifle shorter than the full-grown maggot. Plate XII, b.

(d) The adult is known as the fly of the cabbage root maggot. It resembles the common house fly but is considerably smaller. It has two wings (placing it in the order Diptera) which extend farther back beyond the end of the body and when the fly closes its wings over its back they shut farther over each other than the wings of the common house fly. See plate XII, b.

The fly, especially the female, has no special markings, making it difficult to distinguish it from the other common Anthomyiids, unless found with its male. The female is much lighter in color than the male, and is quite bristled, but not as much as the male. The male fly is dark gray in color, having the abdomen and thorax quite distinctly striped with rather broad blackish stripes. The

legs are black and strongly bristled. The body of the male is very bristly, this being its chief character. On the underside of each hind femur is a tuft of these bristles, by means of which one may distinguish it from allied species. The abdomen is narrow and tapering, being cylindrical in form. The eyes occupy most of the head and nearly touch each other.

The first brood of flies appear early in the spring, the first being captured this year April 30th. As to the number of broods it has been agreed by several entomologists that there are at least three, and, possibly, four broods annually.

The first brood works on the early varieties of cabbage, turnip, radish, etc., usually causing the most damage. This year the maggot was not very abundant in the fields where experiments were carried on. Some turnips were planted at the Station farm adjoining the cabbage plant. They were examined on May 23rd and found to be quite badly infested. On June 25th, when harvested, the injuries had grown over, but they appeared unsightly.

A second brood has been recorded as appearing the middle of June and the maggots feeding on cabbages and turnips during July. During July most of the food plants, such as early cabbages, radishes and turnips, are harvested, and, therefore, it is a question as to what the third and fourth broods have to feed on. Late cabbage has been reported as being damaged more or less, but in Connecticut they are seldom attacked, and only the early crop is seriously injured. In 1891, a large field of turnips, in Ithaca, N. Y., were greatly damaged, and maggots were feeding on them as late as October 2nd. It is, therefore, evident that there is a third brood, and possibly a fourth brood of this pest.

On November 5, 1914, a field of late Swedish turnips, or rutabagas, belonging to Mr. A. E. Plant of Branford, Conn., was inspected. Nearly every root showed more or less injury by maggots, resembling that caused by the cabbage root maggot. Adjoining this field Mr. Plant had a field of early turnips which had been destroyed by maggots, and the crop was a complete failure. Several maggots were found feeding at this time on the late turnips and brought to the laboratory in order to secure adults. The maggots are undoubtedly of a late brood of the cabbage root maggot.

The flies are known to hibernate in rubbish, holes and crevices for the winter. It has also been recorded that the pest passes the

winter in both the larval and pupal stages. The general belief is that the most common form in which the winter is passed is the puparium stage, although it's passed in all three stages—the maggot, puparium and the adult.

FOOD PLANTS.

The cabbage root maggot confines its food chiefly to the Cruciferae or Mustard family. Cabbages, cauliflowers, radishes, turnips, brussels sprouts, kales and collards, being the most common food of the pest. It also feeds on some mustard-like weeds, the hedge mustard, *Sisymbrium officinale*, and the common winter cress, *Barbarea vulgaris*.

ENEMIES.

Chickens are sometimes turned into an infested field and destroy many maggots, but they generally cause considerable damage to the plants themselves. A small hymenopterous parasite, a Cynipid, belonging to the genus *Trybliographa*, has been found to work on this pest. One of the Staphylinidae, or Rove beetles was found in 1870 by Mr. Sprague and described as *Aleochara anthomyiæ*. Some rove beetles were found this year attacking maggots. In 1887 another enemy was found in Michigan, in the form of a mite, a species of *Trombidium*, three of which sucked on an average of 28 eggs per day. A four-winged Ichneumon, *Alysia manducator*, Panzer, belonging to the order Hymenoptera, family Ichneumonidae, known as the Ichneumon-flies, lives in the pupæ of flies allied to Anthomyidae in Europe. It transforms in a thin yellow case within the pupa and emerges during the summer. It has often been found about decaying turnips, and, therefore, it may be a general parasite of these flies.

METHODS OF CONTROL.

Cultural Practices.

To obtain the best results cabbages should not be planted on ground that has previously been infested with maggots. This will not prevent the attack, but on new ground there is less damage from hibernating flies near infested territory. The adult has a tendency to hibernate in old stumps and rubbish near where the attack has been made the previous season. It will not travel

far beyond the infestation if it can find a sheltered place in which to hibernate.

Rotation of crops is strongly recommended on ground that has been infested, using care that such crops are other than those of plants belonging to the Cruciferæ family, or onions.

Clean culture is most important in controlling the cabbage maggot, as well as several other pests infesting truck crops. During the season, clean culture will lessen the attack, especially if all weeds of the Cruciferæ family are destroyed. In the fall all refuse should be removed from the field, such as the stumps, and burned. If this is practiced, the attack the following spring will be greatly lessened.

It has been stated by Riley and Fletcher, that fall plowing will undoubtedly destroy many pupæ, and, therefore, lessen the attack the following spring. These cultural methods are only recommendations and help to some extent. In Connecticut, however, they are not sufficient means of control, some artificial means being necessary.

Artificial Applications.

Tarred Paper Disks.

Tarred paper disks have been used and recommended since 1889 and have up to the present time proved to be the one best mechanical method of preventing the adult fly from laying its eggs on or near the plant. Many other repellents have been tested out from time to time and have proved to be either ineffective or too expensive. No injury to the plant is caused by these disks, and once applied they are effective for the season and require less attention than any other method of control thus far recommended.

The idea of using paper disks originated with Professor W. W. Tracy of Detroit, Michigan, who tried manila paper, which proved unsuccessful. Professor E. S. Goff of the Wisconsin Station, tried one-ply tarred disks, which have since proved successful. Later, Slingerland conducted some experiments with tarred paper disks on Long Island, N. Y. In 1908 tarred paper disks were tried by this Station at Mt. Carmel and Branford, with favorable results.

The disks are not a destructive method of control but act as a preventive. They are made with a tool devised by Professor Goff, which will cut a six-sided card with a slit reaching from the

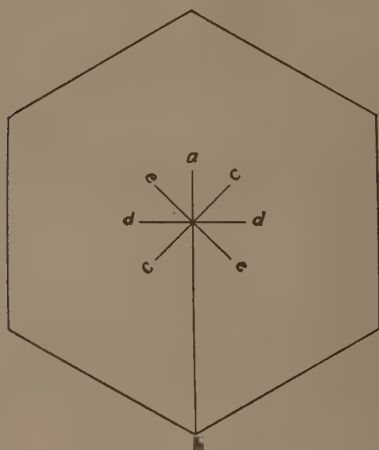


FIG. 4. Hexagonal disk of tarred paper for use on stems of cabbage plants.

center of one side to the center of the disk and with a star-shaped cut at the center. (See plates X, b, XI, b, and figures 4, 5 and 6.)

This cut at the center is made so that the disk will fit closely around the stems of different sized plants. The six-sided disks are used for convenience and economy in making. These disks should be applied as soon as the plants are set in order that the adult fly will have no chance to lay its eggs beforehand.

To apply, slip the disk around the plant through the slit from the side to the center. It is very essential that the disks be applied properly. They should fit tightly around the stem of the plant and rest flat on the ground so that the fly cannot crawl beneath the disk and lay her eggs near the stem of the plant. Care must be taken, when cultivating, not to cover the disks with too much soil; if this is the case their effectiveness will be lost.

The disks are easily made with the tool (Plate XI, b.) one man being able to cut from 300 to 500 disks per hour. Enough paper can be bought for fifteen cents to make 1,000 disks.

One-ply tarred paper is used in the making of these disks with the tool (Plate XI, b); the paper being cut along at the edge at the start, with one angle of the tool. Starting on the left hand side the second cut is made by placing the cutting edge as shown by dotted line in figure 5.

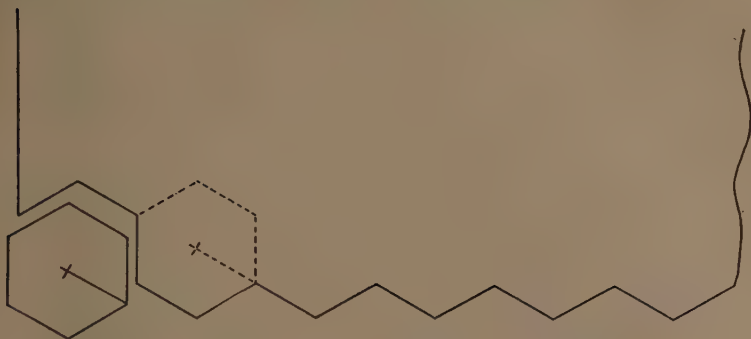


FIG. 5. Diagram showing method of cutting disks.

In 1908, this Station being unable to purchase any ready-made disks devised a method of making them, without any special tool. They were cut from a roll of tarred paper, hexagonal in shape and four inches across. Figure 5 and Figure 6 show the method of cutting them. A block of wood hexagonal in form, and one-quarter inch thick was used as a pattern. A tack being driven through to mark the center, and to prevent the form from slipping. The form was placed on the paper and cuts were made around it with a sharp knife. When several disks were cut in this way, they were piled one upon another and the cut a—b made (Fig. 4); with the knife. With a chisel $1\frac{1}{2}$ inches wide cuts c—c, d—d, e—e, were made. When the first row of disks have been cut from the roll of paper, it will have an edge with regular points, forming two sides on the second row of disks. This method of cutting disks, while being practicable where only a few are needed would not be practicable for large growers of cabbages.

Mr. Farnham of New Haven had a tool made this season cutting the paper three inches square, with a slit from the center of one side to the center of the disk where a circle had been cut. As this circle at the center was cut the same size for all plants, it consequently did not fit snugly around different sized stems, thus

losing the effectiveness of the disk. They did not remain in place as well as the disks used by the Experiment Station and made by Hirsch Bros., of Middle Village, L. I., N. Y.

There are several concerns which sell these disks, the following having been recently recommended: Hirsch Bros., 2257 Metropo-

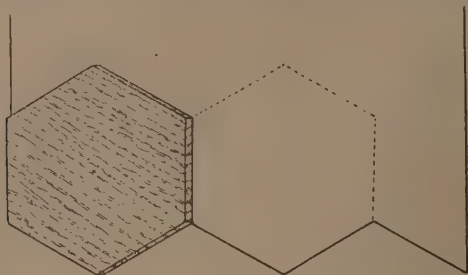


FIG. 6. Wood form for cutting hexagonal disks.

itan Ave., Middle Village, L. I., N. Y.; Smith Bros., Green Bay, Wisconsin, and A. B. Cowles, 25 South Water Street, Rochester, N. Y.

Crude Carbolic Acid Emulsion.

In the experiments carried on in New York State and in Connecticut, Crude Carbolic Acid Emulsion has proved to be one of the most effective methods of control. It acts, not only as a probable preventive, but also kills the eggs and young larvæ of the maggots, if present at the time the application is made.

The emulsion was used according to the formula recommended by the New York (Geneva) Experiment Station.

Hard soap 1 lb. or soft soap 1 qt.
Boiling water, 1 gal.
Crude Carbolic Acid, 1 pt.

The soap is dissolved in the water while boiling hot, the acid is then added and the whole is churned, as in making kerosene emulsion. This emulsion is to be diluted 30 times its bulk of water. If any injury should be caused from the emulsion, dilute still more. Use *crude* carbolic acid as it is cheaper and just as effective.

Mr. W. J. Schoene of the Geneva Station carrier on some very successful experiments determining the effect of this acid emulsion upon the eggs and larvæ of the maggot. In 1913, Mr. Schoene found by his experiments that when Crude Carbolic Acid Emulsion was diluted until it contained only .33 per cent. acid it would prevent the eggs of the maggot from hatching. At this strength it was also found to kill the maggots of the first and second instars, also a few of the maggots of the third instar were killed when first molted.

Carbon Disulphide.

Carbon disulphide has proved practicable, and is both the most effective and the cheapest method for killing maggots attacking cabbage and cauliflower; for other crops, such as onions and turnips, it would be too expensive. One teaspoonful is sufficient to treat a fair-sized plant, and as this can be purchased in large quantities, from 10 to 12 cents per pound, 10 plants can be treated for one cent. One treatment is sufficient and should be applied in May when the first maggots are found. The method of applying the liquid is to first make a hole with a stick, two or three inches from the stem on the surface and slanting towards and underneath the roots. Pour the liquid into this hole and close it at once with the foot. Do not have the liquid come in direct contact with the roots, and care should be taken not to breathe the fumes as it is very poisonous. The fumes will penetrate through the soil around the plant and kill the maggots. The "McGowen Injector" was devised for this purpose and was recommended by Slingerland as the most effective method of applying the liquid, but at the present time it is not on the market.

Kerosene Emulsion.

Kerosene Emulsion has been recommended as a method for the control of the maggot. The following formula, recommended by this Station, was used in our experiments this season:

2 gal. Kerosene
½ lb. Common soap
1 gal. Water.

Dissolve the soap in hot water, add the kerosene and churn together until a white creamy mass is formed, which thickens on cooling. Dilute nine times before using. Although this emul-

sion will probably not be as effective and practicable as the carbon disulphide, or the crude carbolic acid emulsion, it has nevertheless, proved quite effective if applied properly. Two or three applications for cauliflower and cabbage is recommended, while for onions several applications are necessary. In several cases injury to the plants has been reported from the use of it.

Corrosive Sublimate.

In an article in the Market Grower's Journal, May 1, 1914, Mr. J. Peterson, Cuyahoga County, Ohio, states that corrosive sublimate applied to cabbage as soon as there are any indications of maggots, will prove very effective. Two applications were made and applied with a watering can, from which the rose had been removed, at the rate of one teacupful to a plant.

Formula used: Four ounces of corrosive sublimate to 55 gallons of water. One man being able to treat 1,000 plants in three hours.

BIBLIOGRAPHY

- | | |
|--------------------|---|
| Britton, W. E. | Eighth Report. Conn. Agr. Expt. Station, pp. 832-837, 1908. |
| Chittenden, F. H. | Insects Injurious to Vegetables, pp. 131-135, 1907. |
| Curtis, John. | Farm Insects. Page 144, 1859. |
| Lintner, J. A. | Report of State Ent. N. Y., I. p. 199, 1882. |
| | Report of State Ent. N. Y., V. p. 157-158, 1896. |
| Ormerod, E. A. | Manual of Injurious Insects, p. 25. |
| Peterson, J. | Market Grower's Journal, May, 1914. |
| Slingerland, M. V. | Cornell University Agr. Expt. Station, Bull. 78, 1894. |
| Smith, J. B. | N. J. Agr. Expt. Station. Bull. 200, 1907. |
| | Economic Entomology, p. 361, 1896. |

FIELD EXPERIMENTS IN CONTROLLING THE CABBAGE ROOT MAGGOT IN 1914.

BY W. E. BRITTON AND QUINCY S. LOWRY.

Experiments in controlling the cabbage root maggot were conducted in three places in 1914, as follows: At the Station farm, Mt. Carmel, on the truck farms of Mr. A. N. Farnham, New Haven, and Mr. W. G. Griswold, Wethersfield, to whom we are indebted for their kind help and co-operation.

The following materials were used:

1. Tarred paper disks.

2. Sludge, (residue from manufacture of lime-sulphur mixture.)
3. Kerosene Emulsion.
4. Crude Carbolic Acid Emulsion.
5. Naphthalene (Moth balls.)
6. Fish Oil. (With sand and with sawdust.)
7. Sirenia Oil.
8. Cresol.

The details of the treatment are given in the following pages :

EXPERIMENTS AT MR. FARNHAM'S, NEW HAVEN.

The field where these tests were made is located between Derby Avenue and Chapel Street and nearly west of the new Yale Bowl. It is one of many fields devoted to the growing of truck crops by Mr. A. N. Farnham. The plants were grown by Mr. Farnham, and were set by his men, on April 22nd, in rows three feet apart and 465 feet long, extending northeast and southwest. The plants were set 18 inches apart, and 310 in a row. About 30,000 plants were set on the whole field.

Five rows, containing approximately 1,550 plants, on the east side of the field were placed at our disposal for experimental tests. The varieties were Early Jersey Wakefield and Early Flat Head, and the plants showed no signs of being infested at time of setting. The rows were divided crosswise into five equal sections, each containing about 310 plants, and treated as follows:

Section I.	Section II.	Section III.	Section IV.	Section V.
Tarred paper disks.	Check.	Cruded Carbolic Emulsion 3-applications.	Sludge 2-applications.	Kerosene Emulsion 2-applications.

On June 26th, after the insects had done most of its damage for the year, all plants were examined and records made.

SECTION I. The disks were applied the same day that the plants were set and were of the hexagonal type, described on page 147. Five plants out of 307, or 1.6 per cent., were afterwards killed by maggots. This is as small a proportion as was obtained from any treatment in our experiments this season.

SEC. II. Section II, adjoining the tarred paper disk section was left untreated as a check. Here 28 plants out of 308 or 9.1 per cent. were subsequently killed by maggots.

SEC. III. Treated with Crude Carbolic Acid Emulsion, prepared according to the formula used and recommended by the N. Y. (Geneva) Experiment Station, and described on page 150 of this report. This emulsion was applied the day following the setting of the plants, April 23rd, using about 3 ounces to each plant. (This emulsion has been recommended to apply about the base of the plant the day after setting and to repeat every ten days until about May 25th, and to use $\frac{1}{2}$ cupful to each plant, pouring it about the roots with a sprinkler.) On May 4th and May 22nd, second and third applications of Crude Carbolic Acid Emulsion were given to this section, making three in all. There was no apparent injury from the emulsion, and the total number of plants killed by maggots was five, or 1.6 per cent., the same as where the tarred paper disks were used, these two treatments giving the best results.

SEC. IV. Sludge. This is a residue of lime and sulphur having the form of a gray paste, and was applied to the plants of this section April 27th. The following analysis was made by the Chemical department of this Station:

Water.....	26.53
Oxides of iron and alumina.....	1.40
Lime.....	28.82
Magnesia.....	3.76
Free sulphur.....	0.27
Sulphur as S O_3 (Sulphate).....	2.23
Sulphur as S O_2 (Sulphite and thiosulphate).....	13.66
No sulphides present.	

A mixture of sulphate (very small) sulphite and thiosulphate of lime and magnesia with carbonates.

The sludge, as received from the manufacturer, was diluted about five times its bulk with water, 3 ounces being used for each plant. The paste was applied with a ladle around the base of the plant and was very easy to prepare and apply. When it dries it hardens, forming a disk-like coating about 4 inches in diameter around the stem of the plant on the surface of the ground. On May 21st, a second treatment was given. On May 27th, when a comparison was made of the entire five sections, this section treated with sludge, had by far the best looking plants, as one glanced over the field. Mention should also be made that cut worms did the least damage in this section. The total number of plants killed by maggots were 10 out of 302, or 3.3 per cent.

SEC. V. Kerosene Emulsion, was applied to this section, using the standard formula from the Spray Calendar of this Station as follows:

Kerosene.....	2 gals.
Common soap.....	½ lb.
Water.....	1 gal.

Dissolve the soap in hot water, add the kerosene and churn together until a white creamy mass is formed, which thickens on cooling. Dilute this emulsion nine times before using.

On April 30th the first application was made, using two ounces to each plant, applied with a ladle. On May 22nd a second treatment was given. When examined, May 27th, this section compared unfavorably with the other sections and had much smaller plants, and more had been killed by maggots. Possibly some injury was caused by the emulsion, as the total number of plants killed was 52, or 16.7 per cent. more than in any other section.

The following results, therefore, were obtained this year at Mr. A. N. Farnham's.

SUMMARY OF RESULTS AT MR. FARNHAM'S

Treatment.	Results.
Tarred Paper Disks.....	1.6% Maggoty
Crude Carbolic Acid Emulsion.....	1.6% "
Lime Sulphur Sludge.....	3.3% "
Kerosene Emulsion.....	16.7% "
Check.....	9.1% "

EXPERIMENTS AT STATION FARM, MT. CARMEL.

A small plat of ground, on which cabbages have not been grown for many years, being assigned for this work, plants were purchased from a local dealer and set May 6th and 7th, 18 inches apart in 20 rows, extending east and west, and containing 54 plants each. Beginning on the lower or north side, rows 1-4 were treated with tarred paper disks: rows 5-10 received sludge prepared as described on page 154; rows 11-14 untreated, as a check; rows 15-17, fish oil, mixed with sand on row 15, and on rows 16 and 17 the same kind of oil was mixed with sawdust. In each case a handful of the material was scattered around each plant on the surface of the ground; rows 18-20, naphthalene (moth balls) a ball being placed 1½ inches from the stem of the plant and pressed firmly into the soil.

The plants mentioned above were of the Early Jersey Wakefield variety. When setting it was noticed that some of the plants showed that they were infested with "Club-root," a fungous disease, and were discarded. Some affected plants must have been overlooked, because this trouble afterward became so bad as to spoil the results of the experiments.

The 20 rows did not fill the ground available, so on May 16th five rows of a later variety of cabbage called "Succession" and four rows of "Snowball" cauliflower were set.

On rows 21 and 22 of cabbage sludge was used, as on rows 5-10, mentioned above. Row 23 was treated with an oil called "Sirenium" designed "for driving flies from horses and cattle." This oil has a strong odor, and one pint was mixed with four pints of sawdust, and a handful scattered around the stem of each plant in the same manner as the fish oil on rows 15-17, mentioned above. On rows 24 and 25 an emulsion of Cresol (Merck) U. S. P., diluted 30 times, was applied by pouring from a ladle, about three ounces around each plant. The next day the plants were all dead. The ground was dug up and on May 19th more "Succession" plants were set but left untreated. Of the four remaining rows planted to cauliflower, row 26 was treated with sludge, row 27, left as a check, rows 28 and 29 were treated with kerosene emulsion.

The late-planted cabbages and cauliflower plants were not greatly injured by maggots and nearly all produced good heads. There was no apparent injury from the treatment, except in case of Cresol, which has been mentioned.

The early-set plants, however, were so badly attacked by "Club-root" that many plants died, and though some of these were also attacked by maggots, no accurate record could be made regarding the amount of damage caused by that insect.

EXPERIMENTS ON MR. GRISWOLD'S FARM, WETHERSFIELD.

On May 19th, Mr. Lowry visited "Fair View Farm," owned by Mr. W. G. Griswold, Wethersfield. Early Jersey Wakefield plants had been set a few days before, and though no maggot injury was apparent wire-worms had already caused considerable damage. A section of the field was placed at our disposal for experiment. On one end of the first two rows, 500 tarred paper

disks were placed. The third row was left untreated, as a check, and on the fourth row sludge was applied to 250 plants.

There was very little damage from maggots to the field as a whole. When examined on July 3rd, plants were missing from these rows as follows:

Row 1.	Tarred paper disks.....	17 plants.
" 2.	" " "	27 "
" 3.	Check.....	24 "
" 4.	Sludge.....	36 "

The cause of the missing plants, as has already been explained, was chiefly due to the attack of wire-worms instead of the cabbage maggot.

The only positive results of these tests may be seen in the summary of results at Mr. Farnham's on page 155, from which it appears that the tarred paper disks and the carbolic acid emulsion are about equally effective in preventing damage from maggots, and that sludge is fairly satisfactory.

In tests made at the Station farm, Mt. Carmel in 1913, the tarred paper disks reduced the injury to one-half of one per cent., though the untreated plants showed 12 per cent. injury.

Directions for making these disks at home and information about purchasing them are given on page 147.

OUTBREAK OF THE ARMY WORM.

Heliophila unipuncta Haw.

Order Lepidoptera: Family Noctuidæ.

In 1896 the army worm appeared in Connecticut at Hartford, Springdale, New Haven, and probably other places, and a brief account of the outbreak may be found in the report of this Station for that year, page 236.

On July 20, 1914, during the writer's vacation absence from the State, it was reported to the office that army worms were abundant and devouring the grass on lawns, as well as corn, in private gardens in New Haven. Mr. Walden, who was in charge of the office, gave directions for treatment and sent Mr. Zappe to investigate the report. In a garden owned by Mr. Kligerman at 334 York Street, Mr. Zappe helped the owner to spray his corn with lead arsenate, 1 oz. in a gallon of water, and to spray the ground with kerosene. The next day when Mr. Zappe examined

the garden, he found many dead army worms. The following day, July 21st, it was reported that this insect was present on the grounds of Mr. Morton F. Plant at Groton, and that Professor G. H. Lamson, Jr., of the Connecticut Agricultural College at Storrs, had visited the place and had directed Mr. Plant's men in their efforts to control the pest. On July 23rd the army worm was said to be causing great damage in Bridgeport, and the Associated Press telephoned to this office for information. During the next week, or ten days, newspapers each day gave accounts of injury in some part of the State.

Mr. Walden prepared a brief account of the pest, giving control methods, which was published in the *Connecticut Farmer*, issue of July 25th.

The writer returned to Connecticut, Saturday, July 25, and took up his duties at the office on the 27th, when the telephone calls and letters about the army worm were the most abundant.

On July 27, Mr. Walden visited the farm of Mr. H. B. Clark in New Canaan, where considerable injury had already been done to a 5-acre field of oats. Along the east side and north end, many of the leaves and heads had been eaten off. The owner had plowed a furrow around the field to keep the worms from the corn field and the garden, and had sprayed a few rows of corn with poison. At this time the worms were less abundant than two days before, and were apparently under control.

On July 28, the writer visited "Fairlea Farm," owned by Mr. Wilson H. Lee, in Orange. The worms were abundant in three oat fields where in spots they had devoured all the leaves and had eaten off the heads which had dropped to the ground, leaving only the bare stalks. They were also present in grass fields and some were found on alfalfa, though apparently they had not been feeding upon it. They had commenced to attack the corn along one side of the field, but had not caused much damage to it. A part of the worms had already gone into the ground and transformed to pupæ. Many birds, especially starlings, barn swallows and English sparrows, were abundant on the field and were apparently eating the worms. Many worms were collected and brought to the laboratory: forty per cent. of these had Tachinid eggs fastened on their backs near the head. Clusters of small hymenopterous cocoons were present in great abundance, particularly under piles of straw where the worms congregated in large numbers coiled up

like cut worms, to which they are closely related. Dead and diseased worms were common on stalks of grass and alfalfa, having been attacked by a "wilt" disease. Specimens were collected of all these parasitized caterpillars, and the parasites causing their death are mentioned under Natural Enemies, on page 166.

On July 31, Mr. Walden visited the farm of Mr. I. H. Todd, Centerville, where an acre field of millet had been completely stripped of leaves and heads, leaving only the stalks. The worms were about through feeding, and the contracted larvæ and pupæ were found in the soil where they had gone to transform. There was considerable evidence of the presence of Tachinid parasites. A corn field near by had not been damaged.

At one place in Orange the worms were reported as attacking corn, oats and melons, and in Cheshire they were feeding upon wheat.

Circular letters were prepared giving a brief account of the insect and how to control it, and copies were sent to all known addresses of those who had written or telephoned to this office about the army worm. A shorter abstract was given to the press associations, and a more complete article with illustrations, was prepared by the writer and sent on August 10 to the *Rural New Yorker*, wherein it was published in two instalments, in the issue of August 22, page 1027, and August 29, page 1047.

The outbreak was not confined to Connecticut, but occurred throughout the Northeastern States as far west as the Mississippi River. From newspaper reports it was present in Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, Maryland, Virginia and Michigan. Its attack was said to be particularly severe on Long Island, in Maryland, and also in Michigan, where the damage was estimated at \$1,000,000.00.

LOCALITIES INFESTED.

Specimens of the worms were received from several places in New Haven, where they were feeding on the grass of lawns and upon corn; from East Haven, on corn; Bridgeport, on grass; Hartford, on corn; Colchester, on rye; New London, on grass; and from Stamford, on oats. By telephone, or letter, the army worm was reported also from North Haven, Orange, Hamden, Cheshire, Foxon, Old Lyme, Moosup, Northfield, Newtown, Fairfield and New Canaan. Mr. Davis reports the insect present in

Stonington, North Stonington and Waterford. Newspapers printed reports of its occurrence at Groton and Monroe. Subsequent additional reports have been given verbally for Milford, Hebron, Lebanon and Salisbury.

Army worm moths were received from Stony Creek and from Southington the last week in August. No doubt the insect was present in every town in the State. If not abundant, however, there would be little or no injury, and it would escape notice altogether.

FORMER OUTBREAKS.

Occasional outbreaks of the army worm have occurred in the United States, during the past 172 years, the first of which we have any record being in 1743, of which the Reverend Thomas Smith of Falmouth, Me., wrote in his diary under date of June 27th. "There are millions of worms in armies appearing and threatening to cut off every green thing: people are exceedingly alarmed." Other outbreaks have been recorded as follows: In 1762, some kind of worms, probably army worms, were exceedingly numerous in Massachusetts and ate up the corn. Considerable damage has been recorded in New England by army worms in 1770, and in 1790, "Millions of the same black worm reappeared in Hartford and Norwich, Conn." Then in 1817 "it appeared in Worcester; also in Albany."

In Illinois, army worms appeared in 1818 or 1820, 1825, 1826, 1834, 1835, 1838, 1839, 1841, 1842, 1845, 1849, 1850, 1856, 1858, 1861, 1865, 1869, 1871, 1872 and 1875, though usually not in the same locality in successive years. It appeared in Missouri in 1854 and in Ohio in 1855.

The outbreak of 1861 seems to be one of the worst on record and reached from Maine westward to Kansas, and as far south as Tennessee.

In 1865, 1866, 1869 and 1872, the insect appeared in Missouri; in 1869 in Indiana and in 1871 and 1872 in Iowa. In 1872 outbreaks occurred in Wisconsin, Ohio, Kentucky and New York. In 1875, the outbreak was even more widespread, and in 1880 the worms caused considerable damage in New Jersey, New York and Connecticut.

The army worm is also recorded as appearing in Nebraska in 1888, in Michigan in 1897, in New Jersey in 1889, 1896 and 1906,

and in Kentucky in 1908. The 1896 invasion was one of the worst in the history of New York State, and also extended through Connecticut, Massachusetts, New Hampshire, Vermont, Pennsylvania, and into Michigan and Iowa.

FOOD PLANTS AND DAMAGE.

The chief damage is done to crops of the grass family including the cereals and corn. The worms eat the leaf-blades and often the heads of the grass or grain, leaving only the stalks. Many oat fields in Connecticut this season were thus stripped of their leaves; the heads were also eaten off and fell to the ground. The writer saw a five-acre oat field similarly injured in 1896, at Hartford; the caterpillars in marching to the adjoining field literally covered the ground over an area perhaps twenty feet wide and more than a hundred feet long. Within this area it was impossible to walk without crushing a dozen or more caterpillars at each step. One could actually hear them crawl upon the ground. Thus when in search of food, army worms will attack fields of corn and many kinds of garden vegetables, which are not ordinarily their first choice. In some places cranberries have been severely injured by them. Clover and alfalfa are not often greatly damaged, yet in New Jersey in 1880 there were cases where the army worm seemed to prefer clover. They seldom attack trees and have only once been recorded as eating the leaves of fruit trees.

During the present season, at least in Connecticut, they were not sufficiently abundant to cause them to migrate from one field to another in large numbers; they were able to get plenty of food in the fields where they were hatched, and in most cases without eating all of it. Oats, barley, rye, wheat, grass, corn and millet were the principal crops damaged.

Like cutworms, to which they are closely allied, army worms feed mostly at night and hide under something near the ground during the day, as shown on plate XIV, b. When the worms are numerous and their food scarce, they are not able to satisfy themselves at night and therefore feed during the daytime.

IDENTITY OF THE ARMY WORM.

Though periodical outbreaks have occurred since 1743, it was not until 1855 or more than one hundred and ten years after

the first recorded outbreak, that the adult moths were first reared by Mr. J. Kirkpatrick in Ohio. In 1861 the life history was worked out by Doctors Walsh and Thomas in Illinois, Dr. Fitch in New York State, and by several others less well known as entomologists. Though the synonymy was very complicated, Dr. Fitch finally succeeded in proving that this species is identical with *Leucania unipuncta* of Haworth, and in most of the literature the army worm still appears under this name. Some writers, however, especially in the later publications, adopted Hubner's generic name *Heliophila* for this species. The name *unipuncta* was probably given to this moth on account of the small white discal spot near the center of each fore-wing, much more prominent in the female than in the male. Dyar's "List of North American Lepidoptera" includes thirty-six other species of the genus *Heliophila*, fifteen of which are found along the Atlantic Seaboard.

The common name "Army Worm" refers to the habit of the caterpillars when abundant, after devastating one field of marching *en masse* onward like an army, seeking another to devour.

There are two other kinds of army worms, the "Wheat Head Army Worm, *Heliophila (Leucania) albilinea* Hbn., which attacks and eats off the heads of grain at the time of ripening, and the "Fall Army Worm" *Laphygma frugiperda* S & A., which appears in September and devours grass, millet, grains, corn and some other crops. The "Fall Army Worm" was described and figured in the Report of this Station for 1912, page 284, and plate XIV.

DISTRIBUTION.

Slingerland states *that although a native of North America, the army worm is now known to occur in South America, England, Australia, New Zealand, India, Java and Madeira, but is not destructive in these countries.

Dyar's "List of North American Lepidoptera" gives *H. unipuncta* as occurring in the Atlantic States, but according to the records mentioned under "Former Outbreaks" on page 160, it has caused damage as far west as Kansas and Nebraska. This insect is common in the Southern States,† though according to some writers it is seldom injurious there. Slingerland quotes‡

* Cornell Agr. Expt. Station. Bull. 133, 1897.

† Report on Noxious Insects of New York, 6, page 113, 1865.

‡ Cornell Agr. Expt. Station, Bull. 133, 1897.

without giving the authority, that it is injurious as a pest in the Gulf region from Texas to Alabama, but east of the Blue Ridge Mountains it causes little damage south of North Carolina.

It has been believed by some entomologists that because the caterpillars have not been seen early in the season and the moths appear in swarms, that the species winters only in the South and that the moths migrate northward in large numbers and then lay eggs which develop into the broods of caterpillars which cause the damage. This theory has not been proven, however, and there is some evidence to the contrary. For instance, Dr. Thomas shows* that the moths have been captured in Illinois as early as April 2, and that the larvæ have been seen as early as April 29th. In Missouri the adults appear early in April and the larvæ were noticed during the early part of May.

In the Station collection, besides material collected in 1914, there are adults bearing the following records: New Haven, Conn., 12 May, 1903, H. W. Foote; 5 May, 1905, 1 August, 1906, B. H. Walden; Hartford, 28 July, from larvæ collected 9 July, 1906, W. E. Britton; Pemaquid Point, Me., August, 1906, H. W. Foote.

From the foregoing it may be seen that the army worm may be considered as occurring throughout the Eastern United States and westward nearly to the Rocky Mountains. Nevertheless it is true that most of the outbreaks in the New England States have been in July.

HABITS OF WORMS AND MOTHS.

It has already been mentioned that the worms naturally feed at night and crawl under some shelter near the ground to hide during the day. In ordinary years they feed upon the grasses and weeds which grow in low meadows and swampy places, usually on land not pastured or cultivated. It should be borne in mind that the great destruction caused by them, and the habit of traveling in armies, is unusual, or rather abnormal, and occurs only when they are very abundant and in need of food. They are then one-half or two-thirds grown. During the years intervening they are doubtless present in their natural habitat, prob-

*Report State Entomologist of Illinois, 10, pages 5-43, 5 figures, 1881

ably in nearly every grass field, and are not noticed by man. Nevertheless, they multiply in these places, and increase to such an extent that they finally overflow and attack the cultivated crops in the vicinity. On corn a worm is often found coiled up in the lower part of the cavity in the funnel-shaped top where the new leaves appear.

The adults, when abundant, are attracted by lights, and fairly swarmed around some of the electric lights in New Haven on August 19 and 20. In the daytime one would find hundreds of them crushed on the walks, some resting on poles or on the sides of buildings or in store windows.

No swarms of moths were noticed at any other time during the season. It might be expected that a swarm late in June, or early in July, would naturally precede such an outbreak of caterpillars, but no such swarm was observed by any members of the entomological staff or reported to the department as occurring in Connecticut.

AN ACCOMPANYING SPECIES.

During the writer's visit to Fairlea Farm he noticed that there were two species of caterpillars at work on the oats and corn. Besides the army worms there were others having darker diagonal shadings on the dorsal surface of each segment. These were distinct after reaching a certain molting stage (probably the fourth), but in earlier stages were not recognized or distinguished from the army worms.

These caterpillars were placed in separate breeding cages and soon pupated. No adults, however, were obtained. Inflated larvæ sent to the Bureau of Entomology at Washington were identified as the W-marked cut worm *Noctua clandestina* Harr.

These caterpillars were feeding with the army worms on the same plants and doing the same kind of damage, but in no case where observed were they anything like as abundant as were the army worms.

LIFE HISTORY.

The female moth lays upwards of 700 eggs, usually in clusters of 50 or less, placed in the sheath or at the unfolded base of a blade of grass or grain. She seems to prefer the rankest and most vigorous tufts or bunches of grass for this purpose, and

after depositing a cluster of eggs covers them with a whitish adhesive substance which holds them together and fastens the edges of the leaf firmly around them. From eight to ten days are required for these eggs to hatch.

The young caterpillars have the habit of looping when they crawl, like Geometrid larvæ, and also spin down on silken threads like canker-worms. Their first food is the egg shells and the glutinous substance covering them, which are wholly devoured before vegetation is attacked. After feeding for a few days, the caterpillars molt and in the second larval stage, as in the first, they are loopers. But after molting the second time, they lose this habit. They molt five times before reaching caterpillar maturity, all within a period varying from twenty to thirty days.

The full-grown army worms work their way into the ground an inch or two beneath the surface, and wriggle about, forming cells or cavities in which they transform to the chrysalis stage. From ten to fifteen days later the moths emerge.

The number of annual broods or generations has not yet been definitely settled for this latitude, but there are at least two complete broods and probably a partial third, or perhaps three complete broods in certain seasons. It is probable that the insect hibernates, or passes the winter as a caterpillar, yet Smith *records the finding of the moth "during the entire winter in sheltered places." Slingerland† concludes that it does not winter as a moth in the latitude of Ithaca, N. Y. Some entomologists believe that the winter is passed as a chrysalis or pupa, but this has not been demonstrated.

Our own records of adults, taken early in May, would indicate that they passed the winter either as adult moths or as pupæ from which the moths emerged early.

DESCRIPTION.

Egg. The egg is white or pale yellow, nearly spherical, almost smooth, but marked with white striæ or ridges, and slightly less than one millimeter in diameter. The eggs are laid in rows in clusters containing from 10 to 50, in the sheath, or in the unfolded leaf, and covered with a transparent gelatinous substance.

*New Jersey Agr. Expt. Station, Report, page 450, 1896.

†Cornell Agr. Expt. Station, Bull. 133, p. 249, 1897.

Larva. The caterpillar is about one and one-half inches long, when full grown, though varying from one and a quarter to one and three-fourths inches. The color is generally brown, though varying considerably, and usually shows tints of green or red, much darker above than beneath, and marked dorsally with fine longitudinal lines of white, yellow, or lighter brown. A broader yellow stripe extends along each side just below the region in which the spiracles or breathing pores are situated. The entire under surface is brown but usually lighter than the upper surface. Head light brown, shining with inverted V-shaped mark on face and reticulated margins on the lateral surfaces, of darker brown. Legs light yellowish brown. Prolegs are of same color as under surface, except that each has a transverse dark band on the outer side, and the tip is marked with black on the inner side.

Chrysalis. The chrysalis is a naked pupa nearly three-quarters of an inch in length and of a light reddish-brown color with glossy surface. The apex bears a pair of spines which are incurved or coiled at the tips.

Moth. The female moth has a wing-spread of about one and three-fourths inches. The fore-wings are light brown or fawn, more or less mottled, with a white discal spot or dot just beyond the center of each, with a dark streak often rather inconspicuous, nearly bi-secting the apical angle. The rear wings are usually lighter at the base and darker on the outer margins than the fore-wings. Under surface of fore-wings dark brown in center, with margins and rear wings light brown; rear wings have a black dot near the center. Head, body above and beneath, with legs and antennæ, all of nearly the same color as the upper surface of the fore-wings, though varying somewhat.

The male is smaller than the female, having a wing-expanse of about one and three-eighths inches, paler and more uniform in color on fore and rear wings, and with less conspicuous markings. The under surface is about the same tint as the upper surface.

NATURAL ENEMIES.

Domestic fowls and native birds devour large numbers of army worms. Of the birds occurring in Connecticut the most important destroyers of army worms are the blackbirds, starlings, robins, thrushes, bobolinks, catbirds and barn swallows. Even the much despised English sparrow has been observed to feed upon them.

Among other vertebrate animals, hogs, skunks, toads and frogs are known to eat many army worms. Certain predaceous insects like ground beetles, and soldier bugs destroy a limited number of them. The larger ground beetles, *Calosoma scrutator* Fabr., *C. calidum* Fabr., *C. willcoxi* Lec., *C. externum* Say., and *C. frigidum* Fabr., are probably the most important for this purpose. We may also expect that the European *C. sychophanta* Linn., which has been brought to this country and planted in the eastern end of the State to aid in destroying gypsy and brown-tail moths, will devour army worms. The five species of the genus *Carabus* occurring in the State, are large-sized ground beetles and may be expected to feed upon them. There are probably many other smaller ground beetles which occasionally devour small army worms.

The soldier bugs belonging to the family Pentatomidæ, spear the caterpillars with their proboscides and suck out the interior juices for food. These are not important checks, however, and it is upon the parasites that we must depend to hold the army worms in check. Of these the most important in Connecticut are a large two-winged fly called the red-tailed fly, *Winthemia quadripustulata* Fabr., and a small four-winged fly, *Apanteles militaris* Walsh.

Forty per cent. of the worms collected at random at Fairlea Farm, Orange, on July 28, bore Tachinid eggs, from which were reared 30 flies all of the same species, *Winthemia quadripustulata* Fabr. Of those collected at New Canaan, July 27, by Mr. Walden, 47 per cent. had Tachinid eggs, from which were reared one specimen of *W. quadripustulata* and three specimens of another Tachinid, *Goniomima (Belvosia) unifasciata* Desv. Of material collected by Mr. Walden at Hamden, July 31, the percentage of parasitism by Tachinid flies was not noted, but from it were reared six specimens of *W. quadripustulata* and one Muscid fly, *Muscina stabulans* Fabr., which formerly was not supposed to be a parasite, but was thought to breed in decaying animal or vegetable matter. In fact, the conditions under which it was reared would hardly preclude the possibility of its breeding in the bodies of some of the worms which had died from the bacterial "wilt" disease.

From army worms collected by Mr. Zappe in New Haven, July 20, six flies were reared, one being *W. quadripustulata*, and the other five *G. unifasciata*. The former is shown on plate XVI, b.

The determinations were made by Mr. W. R. Walton of the Bureau of Entomology, through the kindness of Mr. F. M. Webster, who has charge of the Division of cereal and forage crop insects.

W. quadripustulata is mentioned in many of the early writings on the army worm under the name of *leucaniæ*, and was placed first in the genus *Nemora* and later in the genus *Exorista*.

In the foregoing pages, the abundance of a hymenopterous parasite has been mentioned. Clusters of the cocoons were observed by the writer in oat fields at Fairlea Farm, Orange, where they rested on the surface of the ground between the stalks of oats. The larvæ had evidently emerged from the bodies of the army worms before the latter entered the ground to pupate, and consequently the parasites made their cocoons above ground, though more or less covered with rubbish and by the grass and oat stalks growing in the field. Clusters of these cocoons were also very abundant under the windrows and bunches of dried oats in the field and later the same kind of cocoons were obtained in the breeding cages. They were much more abundant in the material from Fairlea Farm than in that collected at other points. Through the kindness of Mr. F. M. Webster, this parasite was identified by Mr. A. B. Gahan of the Bureau of Entomology as *Apanteles militaris* Walsh. This species was described by Dr. B. D. Walsh in the Tenth Report on Insects of Illinois, page 38, 1881, as *Microgaster militaris*.

Several other hymenopterous parasites have been recorded as attacking the army worm in various parts of the country. These include the ichneumon flies, *Amblyteles* (*Ichneumon*) *suturalis* Say., *A. flavisonatus* Cress., *Ophion purgatus* Say., *Apanteles flaviconche* Riley, *A. congregatus* Say., *Microplitis* sp., *Aleiodes terminalis* Cress., and the chalcids, *Haltichella* (*Hockeria*) *perpulchra* Walsh, *Glyphe viridescens* Walsh, and *Smicra* (*Chalcis*) *albifrons* Walsh.

The literature also mentions the Ichneumonids, *Mesochorus vitreus* Walsh, *Pezomachus minimus* Walsh, and *Hemiteles latinctus* Ashm., but these are now all regarded as hyperparasites, i. e., they are parasitic upon some of the parasites of the army worm. Probably in Connecticut, at least, *Apanteles militaris* is the most important of all the hymenopterous parasites of the army worm.

The "wilt" disease, already mentioned, has been studied somewhat by Mr. E. M. Stoddard, Assistant Botanist of this Station. He found it to be caused, apparently, by bacteria, which he isolated. He has made several inoculations in apparently healthy caterpillars and in each case produced the disease. Mr. Stoddard kindly furnished the following note:

During the latter part of July, 1914, dead larvæ of the army worm were collected in the field which apparently had died of a "wilt" disease. These larvæ were hanging on blades of grass by the last pairs of false legs and presented a wilted and shrunken appearance and were soft and flaccid to the touch. During the last week in July larvæ in the rearing cages of the entomological department developed what was apparently the same trouble, the infection spreading through a large number of larvæ very rapidly. The interior tissue of the diseased worms was in a semi-fluid state, of a greenish yellow color, with a characteristic odor. The digestive tract was largely disintegrated in most of the specimens examined.

An examination of the diseased larvæ showed an abundant infection of bacteria in all parts. An examination at the same time of health larvæ failed to show bacteria in any greater abundance than would naturally be present in the digestive tract or be introduced from the exterior part of the larvæ. On August 1st, Petrie dish cultures on potato agar were made from the diseased worms. These cultures showed colonies of a brilliant pink organism, also colonies of a white organism, the pink colonies being much more abundant than the white. Both organisms were motile rods, the ones from the pink colonies being very sluggish, while the white organisms were very active.

Inoculation experiments were tried, which, owing to the scarcity of suitable healthy material did not give any conclusive results. The ten larvæ taken for inoculation were divided into two lots. Lot 1, three larvæ, taken from cage of healthy worms, two inoculated with the pink organism, and one with the white. Lot 2, seven larvæ, taken from cage of diseased worms, two inoculated with pink organism, three with white, and two checks; the inoculation being done by smearing the mouth parts with material from Petrie dish cultures. All larvæ were put in fresh cages in another room, where the chances of accidental infection were very small. The results of these inoculations were as follows: Two larvæ of Lot 1, inoculated with pink organism, died showing characteristic symptoms of "wilt" and one giving pink colonies in subculture. The larva inoculated with the white organism remained healthy until it pupated. In Lot 2, one larva inoculated with pink organism developed appearance of "wilt" and separation cultures showed pink colonies. However, parasites were later found to be present, which may have caused its death. The remaining larvæ of Lot 2 were either parasitized or pupated in healthy condition.

The results of these inoculations show that of four larvæ inoculated with pink organisms three died of "wilt" presumably and of these three the pink bacterium was recovered in cultures from two of them, while none inoculated from white colonies showed symptoms of wilt at all. Inoculations on red-humped caterpillars gave negative results in all cases.

This disease does not seem to correspond in any particular with bacterial or other diseases described on insect larvæ except in the manner in which the dead larvæ cling to the feeding plants, this being similar to wilted gypsy moth caterpillars, as described by Reiff. No attempt has been made to identify the species of bacteria found, and no further work with inoculation could be done owing to lack of larvæ to work on. The writer, realizing the meager amount of work done, has drawn no conclusions, but simply states the few facts gathered in regard to what is apparently a bacterial wilt disease of the army worm.

PROSPECTS FOR NEXT YEAR.

From a study of the history of former outbreaks in the United States, it appears that seldom, if ever, does the army worm cause serious damage for two consecutive seasons in the same locality. There was practically no damage by the September or late brood of caterpillars this season in Connecticut. The abundance or scarcity of individuals in any species bears an inverse ratio to the numbers of its natural enemies. Thus natural enemies and weather conditions are factors which never cease to exist, and which, though variable and uncertain, occasionally form such a combination as to permit an outbreak. We are not yet far enough advanced in the subject to be able to predict with any degree of accuracy when an outbreak may occur.

From the very great prevalence of the parasites, *Winthemia quadripustulata*, and *Apanteles militaris* it seems reasonable to expect that the army worm will be held in check and that there will be no damage by it in 1915, in Connecticut.

CONTROL MEASURES.

Various methods of control have been recommended from time to time, and, though prompt action is necessary in case of an army worm outbreak, the local conditions must be considered before adopting a line of treatment. Some measures will fit one place, some another and often various combinations of two or more of them may be necessary to bring about the best results. Some of these methods of control are described below:

Pasturing with Domestic Fowls.—In small infestations near the house the hens, turkeys, ducks and geese may be utilized to eat the worms. This method of destruction may often be facilitated by turning windrows, cocks or bunches of hay, straw, or cured oats, in order to expose the worms hiding underneath.

Rubbish around the edges of the field may also be disturbed for the same purpose. The native birds of the locality will also assist the domestic fowls in disposing of the caterpillars when once they are uncovered.

Rolling or Cultivating the Ground.—Small areas in the field, and especially lawns, may be gone over with a heavy roller to crush the caterpillars. On badly infested grain fields it is usually best to remove the straw at once, then to thoroughly disk-harrow the field, or give it a shallow plowing and then harrow thoroughly. By this process many of the pupæ are exposed and eaten by birds, and many more are crushed by the plow and harrow.

Barriers.—Where army worms are very abundant they will strip one field and may be prevented from marching to an adjacent field by the use of barriers such as ditches, walls and highways. These do not act as absolute obstructions, but check the advance of the worms, and, like a fire lane in the forest, give the fighters a favorable place upon which to concentrate their efforts toward control. It is often possible to take advantage of existing walls, roads or ditches for this purpose. In many cases it may be necessary to plow deep furrows across the line of march, around fields to be protected, or around an infested field to prevent the worms from going elsewhere. In such cases the furrow should be at least six inches deep, with the perpendicular or land side straight and clean and opposite the direction of approach of the worms. The furrow may soon fill with worms which can be killed by crushing or by sprinkling with kerosene. In some cases a log drawn back and forth in the furrow was found to be an excellent method of crushing the caterpillars. Deep holes, ten or fifteen feet apart, in the bottom of the furrow are an advantage, because the worms in their attempts to get out of the furrow will crawl along and collect in the holes, where a great many of them can be killed with a quart of kerosene. As with all other barriers, this furrow is not a permanent bar, but serves as a temporary check and as a line of attack where we can easily kill the worms which collect there. In some cases this may be done by crushing, in others by sprinkling with kerosene, or by covering with straw and burning, or by a combination of two or all three methods.

In some cases the worms when migrating from one field to another cover the ground so thoroughly and closely that they may be killed by sprinkling or spraying kerosene upon them. It has

been noticed that the worms will not cross a road which has just been treated with asphaltum oil. In a similar manner they may be deflected from their line of march by sprinkling kerosene or some heavier petroleum oil along the ground, or upon a windrow of hay or straw.

Poisoned Bait.—Army worms, like cut worms, will eat bran mash. To 25 pounds of wheat bran, add one pound of white arsenic or Paris green and mix thoroughly; then add two quarts of cheap molasses, the juice of lemons or oranges and enough water to make a fairly stiff mash which can be thinly scattered at dusk upon the ground. This method is well adapted to prevent damage in the vegetable garden and around the edges of the corn field but, of course, chickens must be kept away from it. Mr. W. J. Warner of Hebron was successful in saving his corn this year by plowing a deep furrow around the field and placing poisoned bran mash in the bottom of the furrow.

Spraying with Poison.—Strips of grass, grain or corn may be sprayed with Paris green or with lead arsenate (6 lbs. of the paste, or 3 lbs. dry, in 50 gallons of water) to kill the advancing worms which feed upon it. If surrounded by such a poisoned strip, uninfested fields may thus be protected.

Cultural Practices.—Fall plowing is usually advisable for the control of army worms. Even immediate plowing and thorough harrowing of badly infested fields will destroy many worms and pupæ by crushing, and by bringing them to the surface where birds can eat them. Grain, if nearly ready to cut when first attacked, may be saved by prompt harvesting, and carting it to a field not infested, to be cured. As soon as it has partially dried the worms will not eat the leaves or pedicels.

LITERATURE.

The following list of references is not intended to be complete but only contains some of those most easily accessible articles which are thought to be of greatest value to Connecticut readers.

- | | |
|-----------------|--|
| Britton, W. E., | Connecticut Agr. Expt. Station, Report, page 236 plate III, 1896. |
| Bruner, L., | Nebraska Agr. Expt. Station, Bull. 5, 8 pages, 6 figures, January, 1889. |
| Davis, G. C., | Michigan Agr. Expt. Station, Report, page 87, 1 figure, 1894. |

- Fernald, H. T., Massachusetts State Board of Agriculture, Circular 22, 13 pages, 2 figures, 1 plate, October, 1914.
- Garman, H., Kentucky Agr. Expt. Station, Bull. 40, page 15, 1 figure, March, 1892. "Constantly present on low damp ground and often injures young oats." Kentucky Agr. Expt. Station, Bull. 58, page 107, 1 figure, 1895. "Worms each year feed on volunteer blue grass along the fence on the Expt. Station grounds." Kentucky Agr. Expt. Station, Bull. 137, 19 pages, 16 figures, December, 1908. Early literature mentioned.
- Lowe, V. H., New York (Geneva) Agr. Expt. Station, Bull. 104, n. ser. 8 pages, 2 figures, 2 plates, July, 1896. New York (Geneva) Agr. Expt. Station Report, page 583, 24 pages, 4 plates, 1896. Reprint of preceding with additions.
- Pettit, R. H., Michigan Agr. Expt. Station, Bull. 160, page 421, 2 figures, June, 1898.
- Riley, C. V., Report of Entomologist, U. S. Department of Agriculture, page 89, plates II and VI, 1881 and 1882. Third Report U. S. Entomological Commission, pages 89-156, 1883.
- Slingerland, M. V., Cornell University Agr. Expt. Station, Bull. 133 26 pages, 5 figures, April, 1897.
- Smith, J. B., New Jersey Agr. Expt. Station, Report, page 449, 5 figures, 1896. New Jersey Agr. Expt. Station, Report, page 540, 2 figures, 2 plates, 1906.
- Thomas, Cyrus, Report State Entomologist of Illinois 10 (5th of Thomas) pages 5-43, 5 figures, 1881. One of the most complete accounts seen.

EXPERIMENTS IN CONTROLLING THE WHITE PINE WEEVIL.

BY B. H. WALDEN.

The white pine weevil continues to do much damage to the white pine plantations in the State. The only practicable remedy that we have been able to advise is to cut the infested leaders in early July before the adults emerge, and either burn them at once or store them in tight receptacles covered with wire netting, with a mesh of the right size to confine the weevils that emerge, and to allow any parasites that may be present to escape.

This treatment, where carried out over a considerable area for several years, will greatly reduce the number of weevils and consequently the amount of damage, as has been demonstrated in the white pine plantations of the state forest at Rainbow. Here the infested leaders are cut each season and stored in large garbage cans, the covers of which have large holes covered with wire netting. While no actual record has been kept, the amount of injury has rapidly decreased, especially during the past two or three seasons.

The objection to the above treatment is that a large number of the leaders will be destroyed during the period that the trees are most likely to be injured—when they are from three to fifteen feet in height.

The adult weevils hibernate throughout the winter and appear on the leaders early in spring, where they feed for about two weeks before laying their eggs. Any method that can be directed against the weevils at this time to prevent them from depositing their eggs is preferable, even though the cost is slightly more, to cutting the leaders after the injury has been done.

In the Eleventh Report of the State Entomologist, page 307, a note was published regarding the spraying of the leaders with either a poison or a repellant.

More extensive tests were made in 1912, using commercial lime-sulphur and lead arsenate. While the results obtained were not considered definite enough to publish, the indications were that either substance was of considerable value in preventing injury by the weevil, when sprayed upon the leaders before the eggs were deposited.

In large plantations it would be too expensive to follow this method of treatment, but in ornamental plantings, where expense is of minor importance, this treatment appears to be worth trying. Commercial lime-sulphur at the rate of one part in eight parts of water, has caused no injury to the pine foliage in our experiments.

Lead arsenate at the rate of six pounds of paste in fifty gallons of water, can also be used without injury.

Dr. E. P. Felt, State Entomologist of New York, in the *Tribune Farmer*, of August 7, 1913, recommended using a net having a diameter of about 15 inches, to collect the weevils on the pine leaders. "This work should begin in April, as soon as the weather is

moderately warm, and be continued for several weeks at intervals of approximately a week or ten days. Practical work done this season shows that it is possible to make four collections from an acre of young pine at a cost of \$1.28 an acre."

EXPERIMENTS AGAINST THE WHITE PINE WEEVIL IN 1914.

During the past season experiments against the weevil were started in a block of about 3,000 young pines, in which the weevil first appeared in 1913, on the State plantation at Rainbow. This work must be continued a number of seasons before the results will be of value to publish.

Collecting the weevils with a net was tried at Rainbow, as well as in the State plantation at Portland. Nets were made having a diameter of sixteen inches, with a notch about three inches deep on one side, against which to strike the leader. After trying the nets it was found that a larger proportion of the weevils could be captured by placing the net well down on one side of the leader and rapping the opposite side of the leader above the net with a stick or lath. (See plate XVIII, a.)

The spring was backward and the first weevils were observed on May 6th. The results from collecting the weevils are as follows:

RAINBOW.

The trees were from five to eight feet high, with no under-brush to obstruct the work. Five collections were made on the following dates,—May 8, 14, 21, 28 and June 3.

	No. Trees.	No.	Leaders Infested
			Per cent.
Net used.....	337.....	9.....	2.64
Check.....	116.....	8.....	6.79

PORTLAND.

The trees averaged somewhat taller than those at Rainbow, and were in thick under-brush, the conditions being decidedly unfavorable for using the net. Four collections were made,—May 15, 23, 29, and June 5.

	No. Trees.	No.	Leaders Infested
			Per cent.
Net used.....	1,462.....	141.....	8.00
Check.....	1,009.....	191.....	18.91

While the figures in the above tables do not show striking results, the percentage of injured leaders where the net was used was less than half the percentage of those injured on the checks.

If the treated trees, next to the checks had been omitted in the count, the results in favor of the treatment would have been greater, as these trees were considerably injured by the weevils from the check trees.

Additional collections would have further reduced the injury, and our experience during the past season indicates that at least six collections could be made at an expense not to exceed \$1.50 to \$2.00 per acre.

EXPERIMENTS IN CONTROLLING A MITE (*TARSONEMUS PALLIDUS* BANKS.) INJURING SNAP-DRAGON PLANTS IN THE GREENHOUSE.

BY W. E. BRITTON, B. H. WALDEN AND QUINCY S. LOWRY.

On January 5, 1914, Mr. Smith T. Bradley, a New Haven florist, brought to the Station some snapdragon plants from his greenhouses. The leaves were badly curled and his entire season's crop of bloom was threatened. An examination showed the plants to be quite badly infested with very small mites, which were identified later as *Tarsonemus pallidus* Banks, by Mr. Nathan Banks of the Bureau of Entomology.

Naturally Mr. Bradley wished to save his plants, and especially their crop of bloom, if possible. Knowing that these mites have an extremely primitive respiratory system, and that it is often difficult to control them satisfactorily by fumigating even with hydrocyanic acid gas, we resorted to sprays as a control measure.

As there seemed to be few or no accessible published records to guide us in controlling this pest, we arranged with Mr. Bradley to carry out some experiments in his greenhouse for this purpose. Consequently on January 7th, Messrs. Walden and Lowry made the first application.

The mites first appeared on the plants in the east bench, and consequently these plants were the worst infested. On some of them every shoot had curled leaves. All had been cut back, except 12 or 14 rows at the end near the entrance, which had been left as checks. On this bench adjoining the checks, 14 rows, con-

taining 56 plants, were sprayed with the nicotine solution "Black Leaf 40," using 5 c.c. (1 teaspoonful) to 1 gallon of water, with naphtha soap added in the proportion of 4 lbs. to 100 gallons of water. The next section of 15 rows, containing 58 plants, was sprayed with "Fir-tree Oil" 6 fluid ounces in 2 gallons of water.

On the west bench the plants were from six to eight inches in height, and had not been cut back. These plants were less badly infested and the leaves were just beginning to curl from the attacks of the mites. Here 8 rows, containing 40 plants, were sprayed with "Black Leaf 40," using 5 c.c. (1 teaspoonful) in 1½ gallons (6 quarts) of water. At the further end and adjoining the plants just mentioned, 7 rows, containing 35 plants, were sprayed with "Fir-tree Oil" 4 fluid ounces in 2 gallons of water.

The spraying was done as thoroughly as possible with a compressed air hand outfit, as shown on plate XVIII, b. The west bench contained a few plants having shoots from 12 to 15 inches tall, which were difficult to cover. The stems were slender and the force of the spray bent them away, so that it was necessary to throw the spray from the opposite direction or from both sides of the bench, in order to drive the liquid into the whorl of leaves at the tips. It would be difficult to thoroughly spray large plants when in bloom.

The applications were repeated on January 14, 22 and 30.

More than half of the plants in the east bench died. Mr. Bradley considered it to be due to the shock of severe cutting back, together with too copious watering.

The plants were examined on February 6. There was no evidence of injury from any of the applications. Some of the checks on the east bench showed some curling from the attacks of the mites, but there was no mite injury to be seen on the sprayed plants on this bench. It was too early to detect any results from the treatment on the west bench.

On February 20, the plants were again examined. The treated plants from the east bench had been removed because so many had died from the causes mentioned. Some of the checks which had not been so severely cut back, remained and showed considerable curling from the mites.

On the west bench, on the portion treated with "Fir-tree Oil" 4 ounces in 2 gallons of water, only two or three stalks showed any evidence of mite injury to the new growth. Some of the plants

which showed curled leaves before treatment, made a clean growth afterward, as is shown on plate XIX, a.

The mites were still causing some injury where the less concentrated "Black Leaf 40" solution was applied, showing that this dilution was not wholly satisfactory for eradicating them. It is believed that the stronger mixture was effective for the purpose, though too many of the plants died to make the test conclusive. The "Black Leaf 40" solution with soap seemed to spread more uniformly, and to coat the foliage better than the "Fir-tree Oil," though the latter was fairly satisfactory in this respect, and was adopted by the owner for future use in controlling these mites.

Summary: Though the foregoing tests are not conclusive and further trials should be made, they present evidence, which may serve as a guide, that "Black Leaf 40" (1 teaspoonful in 1 gallon of water) with the addition of soap, and "Fir-tree Oil" (4 to 6 ounces in 2 gallons of water) will control this mite on snapdragons if four thorough applications in the form of a spray are made at intervals of about a week. On account of expense, the nicotine solution is to be preferred.

OTHER PLANTS INJURED BY *Tarsonemus pallidus*.

Chrysanthemum.

On November 12, 1912, Mr. H. B. Kirk, while inspecting imported nursery stock at a florist's in Bridgeport, was asked to examine some chrysanthemum blossoms which had withered and some of the petals had died and turned brown. Mr. Kirk brought blooms to the laboratory where they were examined by both botanists and entomologists. The only parasites found were very small mites at the base of the petals. The mites seemed to be the cause of the trouble, and were identified by Mr. Banks as *T. pallidus*. A note was published in the Report for 1912, page 296, regarding the matter. This form of trouble was again brought to our attention on October 27, 1914, when we received from Mr. John Coombs, Hartford, some freshly cut chrysanthemum flowers, which had likewise drooped, and some of the petals had withered and died. The same kind of mites were also found at the base of the petals.

In cases where the opening flower is infested it would seem to be a matter difficult to control; yet the mites are probably pres-

ent elsewhere on the plant before the blossoms open. Perhaps a careful examination might reveal them around the buds or on the smaller leaves. If so, the proper treatment would be a thorough spraying with "Black Leaf 40" and soap, or with Fir-tree Oil, as described in the foregoing pages, just before the buds break open.

Cyclamen.

While inspecting imported nursery stock on the grounds of J. J. Goodwin, Hartford, on December 12, 1913, Mr. Lowry was shown some *Cyclamen* plants in the greenhouse which failed to bloom, and which had leaves and buds that were curled and considerably distorted by this same mite *T. pallidus*. On March 16, 1914, *Cyclamen* plants in a similar condition were received from Branford where they had been grown in a dwelling house. These plants were infested with mites which appeared to be the same species. The leaves were curled and rusty and the plants did not bloom. The owner was informed of the cause of the trouble and of the experiments at Mr. Bradley's, and we have received a recent report that the plants are in thrifty condition and as yet seem to be unaffected with the pest of last year.

Tarsonemus pallidus was originally described by Nathan Banks of the Bureau of Entomology, in Proceedings of the Entomological Society of Washington, Vol. IV, page 295, 1899. The type material was collected on the leaves of chrysanthemum in a greenhouse near Jamaica, N. Y., by Mr. F. A. Sirrine of the New York State Agricultural Experiment Station.

Several other species are known to live on the leaves of woody and herbaceous plants in Europe.

A TENT-CATERPILLAR EGG CONTEST.

The tent-caterpillar was unusually abundant in Connecticut in 1912 and even more so in 1913. For a complete account of this insect see Bulletin 177 of this Station, issued in August, 1913.

On account of the great abundance of this insect the Extension Service of the Connecticut Agricultural College at Storrs, arranged a contest for school children in collecting egg-clusters, the child securing the largest number before April 30, 1914, receiving \$25.00.

The teacher whose school collected the largest number was given a scholarship valued at \$25.00 in the summer school of the Connecticut Agricultural College. The Extension Department also offered a certificate of appreciation to the child making the highest score in each town.

Supervisors were appointed to look after the matter. All egg-clusters were brought to the teacher who credited each pupil with the number collected, and destroyed them.

In addition to these prizes, many individuals, granges, village improvement associations and schools offered prizes for the largest number collected locally. All of these agencies together induced the children to gather an enormous number of egg-clusters. I have recently been informed by the Extension Service of the Connecticut Agricultural College that more than 10,000,000 egg-masses were destroyed according to their records. As a matter of fact, none were counted unless a child secured more than 3,000.

Besides the inducement to collect egg-clusters the *Hartford Courant* offered prizes in three series for the best essays by school children on different phases of the life history of the tent-caterpillar and damage caused by it, or on their experiences in working for the prizes. The State Entomologist acted as judge in one of these literary contests. The best essays and the pictures of the winners were afterward published in the *Courant*. All such efforts, of course, help educate the people and would seem to have an important influence on the control of any pest. Yet in spite of these efforts, the caterpillars were exceedingly abundant over large areas of the State. Their nests fairly covered certain apple and wild cherry trees in some parts of the State, particularly in Newtown, Stonington, Waterbury and along the Naugatuck Valley.

Many caterpillars died from a wilt disease and were found stuck to fences, stone walls, and the trunks of trees. On June 5, the writer visited Stonington, and on North Main Street saw the fully grown caterpillars crawling along the sidewalks, swarming on tree trunks, on fences and walls. A wire fence supported by wood posts had from ten to fifteen caterpillars on every post. They were seeking a place to pupate. From the high percentage of parasitization it surely seems as though the pest would soon begin to subside.

MOSQUITO WORK IN CONNECTICUT IN 1914.

In the Report of this Station for 1912, page 270, will be found an account of the great amount of mosquito drainage work done that year in Connecticut, amounting to about 2,700 acres at a cost of about \$26,000. In 1913, less work was done, and a record of this may be found in the Report for that year, page 242. The chief reason that less work was done may be explained by the fact that many waited for the action of the legislature, expecting that the much needed State supervision would be provided. Though the House and Senate passed the measure with the appropriation cut to \$10,000.00, the bill was vetoed by Governor Baldwin after the Legislature adjourned. It was then too late to plan and finance much new work. Nevertheless, some permanent work was done and the ditches previously cut in each town were maintained.

GREENWICH.

In the town of Greenwich, where the chief problem was of an inland nature and concerned with the malarial mosquito, a contract was let to the United States Drainage and Irrigation Co., of New York, N. Y., to overcome by draining, filling, etc., all mosquito breeding places in the southern portion of the town extending back one mile from the coast to a line running parallel with the northern border of the town. This work was done in the summer and fall of 1913, but not completed until winter. This work has been mentioned on page 118 of this Report, as the State Entomologist was called to act as arbitrator, on account of a disagreement between the local health officer and the contractor. A settlement was finally effected, and the writer has since learned upon good authority that where cases of malaria were formerly very numerous, being unofficially estimated as high as 900 in a season, up to September in 1914 there were only 36 cases of which only 15 were new ones. This tremendous decrease in malaria is generally ascribed to the drainage work, and most of the people are enthusiastic over it. It is needless to state that the work will be maintained, and a number of covered tile drains will be installed next year to prevent the breeding of malarial mosquitoes in the now open ditches which constantly contain water, many of them being fed by springs.

MADISON.

A tract of 250 acres at Hammonasset Point in the town of Madison, owned by the Winchester Repeating Arms Co., of New Haven, and used as a testing ground and as a source of salt hay which is used for packing, was drained in the summer of 1914. This work was also done under contract by the United States Drainage and Irrigation Co. Before it was completed owners of adjacent marsh land decided to have their land drained at the same time, so that in all about 310 acres of salt marsh were drained and the breeding grounds of salt marsh mosquitoes in the State were diminished to that extent.

NEW HAVEN.

No new drainage contracts were let in New Haven in 1914, but by means of an item of \$3,000.00 for the purpose in the city budget, the Board of Park Commissioners were able to clean out the old ditches and cut several new ones in the meadows in Edgewood Park and Beaver Ponds Park, thus greatly improving mosquito conditions in these localities.

Two dump breeding areas, one in Beaver Swamp between Henry and Munson Streets, and the other in Mill River Meadows just above the State Street bridge, have now been acquired by the city and will be cleaned and made parts of the park system.

The Anti-Mosquito Committee of the Civic Federation made no general effort to raise funds for mosquito work in 1914, but an unexpended balance enabled it to maintain the ditches cut in 1912. Mr. James E. Hitchcock, a high school student employed on the work both in 1912 and in 1913, was employed during his summer vacation. He patrolled the ditches on the salt marsh after each high tide and removed obstacles.

The ditches are often filled by hay-makers who wish to drive across; and they always leave the sods in the ditches, thus forming a mosquito breeding area. Mr. Hitchcock remedied several such defects; the remainder of his time was spent in scouting for breeding places, in looking up records of the ownership of land where mosquitoes breed, and in placing evidence in the hands of health officers. The law (Chapter 143, of Public Acts of 1913) declares all such mosquito breeding places a public nuisance and makes it the duty of the health officer to cause such nuisances to be abolished or abated.

One important improvement is the new tide gate on Morris Creek, between South End Road and Lighthouse Point, which was installed late in 1914. This prevents the flooding of the meadows at Morris Cove, ditched in 1912, except by fresh water, and should prove a great benefit, not only from the anti-mosquito standpoint but also to the owners of the land.

WEST RIVER.

In August it was found that West River, which was such a prolific breeding place of *Culex pipiens* Linn, in 1913 was also furnishing a lesser number in 1914. This matter was reported to the local board of health, and at a meeting of the board the State Entomologist was called in conference with some of the factory owners chiefly responsible for the pollution of the stream. It is on account of this pollution which kills or drives away the fish, that the river is a mosquito breeding place. It was arranged that the factory owners equally contribute money to defray the cost of oiling and that Mr. Hitchcock should be furnished by the Civic Federation to take charge of the work. Consequently the stream was oiled once about the middle of August, at a cost of \$102.35. Cooler weather followed with heavy rains in October so that it was unnecessary to oil again.

It is expected that a sewer will soon be installed in this section to take care of the refuse from the factories, thus removing the pollution from the stream which can then be restocked with fish and no more be a breeding place and a public nuisance.

CATERPILLARS FEEDING ON GREENBRIAR.

On August 29, 1912, caterpillars of a noctuid moth were received from Mr. T. I. Coe, of Kidd's Island, off Stony Creek, Branford, where they were feeding on the wild *Smilax* or "greenbriar" *Smilax rotundifolia*. Mr. Coe wrote, "I am sending you herewith several specimens of a worm which came to my notice for the first time this morning. A careful search of the foliage revealed dozens of the worms ranging in size from one-fourth to one and one-fourth inches. They were usually found in clusters on the stems of the vines or on the underside of the leaves. Though I have been a summer resident on this Island, one of 'The Thimbles,' for ten years and have noticed many varieties of

interesting insects, etc., I have not seen the accompanying species before, and its presence in apparently large numbers leads me to wonder if it is something we should endeavor to exterminate."

As we did not recognize the caterpillars and the material was rather scanty, we asked Mr. Coe to send more. This arrived August 31, and though we gave it the best of care, did not succeed in obtaining any adult moths. Consequently again August 7, 1913, we wrote to Mr. Coe for additional material which reached the laboratory September 13, 1913. From this lot of caterpillars there emerged on June 18 and 22, 1914, two moths which proved to be *Hadena turbulenta* Hubn.

The caterpillars are characteristically and strikingly marked and are well shown on Plate XII, d. The following description was made at the time the first lot of caterpillars were received in 1912:

Length 30 mm. (1 1/5 inch) thickness 4 mm. Dorsal surface extending laterally to spiracles, striped longitudinally with narrow yellow and black lines of equal width. First and anal segments have markings of a striking and peculiar pattern shown in the illustration. Lateral view shows below spiracles a ground color of light yellow with longitudinal orange stripes. Ventral surface yellow. Head black, shining, face with a $\wedge$ -shaped indentation all black. Legs black outside, marked with yellow inside. Tips of pro-legs black, bases yellow. Smooth throughout, no tubercles or hairs.

The cervical shield is also black, with a narrow rear margin and a front marginal row of spots which are yellow. The anal extremity is also black above, with spots of yellow arranged as shown in the illustration.

The adult is a light brown moth, with fore-wings marked with darker brown and having a wing-spread of about one and one-fourth inches, shown on plate XII, c.

This species is listed in "Insects of New Jersey" by J. B. Smith, as occurring "throughout the State, local; larva gregarious on 'Smilax'-greenbriar and horse nettle."

Though the greenbriar is generally considered a nuisance and insects feeding upon it would hardly be called injurious, there are places where the owners wish to preserve the native plant growth and in such places this insect might be called a pest. On account of its striking appearance it is mentioned here. Spray-

ing with lead arsenate would, of course, destroy the caterpillars and thus prevent defoliation of the vines.

TEST OF A COMMERCIAL PREPARATION TO PROTECT SEED CORN.

BY W. E. BRITTON AND QUINCY S. LOWRY.

This preparation sold under the name of "Corbin" was stated on the label to be "a protection for seed grain, for corn, wheat, barley, white beans, etc. Use 1 pint of Corbin to $3\frac{1}{2}$ bushels of seed. Do not mix Corbin with water. Price, 75 cents per pint. Use enough Corbin to cover seeds with a brown coating." This is apparently a coal tar preparation dark brown in color, and with a coal tar odor.

On May 18, 1914, three pints of seed corn were treated with Corbin, and planted in hills, each containing four seeds. The treated seeds were planted in every second row, the intervening alternate rows being planted in the same way with untreated seed of the same variety. There were ten rows of each.

On June 1, plants from the seed treated with "Corbin" were much smaller than those from the untreated seed. There was apparently no particular injury from seed maggots or wire worms. A careful count was made of the plants on this date. The treated seed gave an average stand of 3.03 instead of four plants per hill; the untreated seed gave an average stand of 3.74 plants per hill. A difference in size of plants could be noticed for several weeks.

In order to make sure that the coating retarded or otherwise affected the germination of the seed, laboratory tests were made later by an assistant in the botanical department with the seed testing apparatus. Of the untreated seed, 95.5 per cent. germinated within one week, while the seeds treated with "Corbin" showed a comparatively low percentage. Thinking that the treatment retarded germination only, the treated seeds were allowed to remain in the apparatus for one month, at the end of which time only 53 per cent. had germinated.

Even though this preparation does protect seed against injury from seed maggots, wire worms, squirrels and crows, it appears to reduce the percentage of germination, and also to retard development where the vitality is not impaired, to such an extent that its value is questionable.

ENTOMOLOGICAL FEATURES OF 1914.

The winter of 1913-1914 was marked by long periods of low temperature, the mercury several times dropping a number of points below zero in New Haven and going much lower inland. Peach buds were killed, except the hardiest varieties, and for a strip along the coast. The severe winter might be expected to destroy some forms, at least, of insect life, and so we made observations to see if the absence of any injurious species could be attributed to the severity of the winter.

The spring was late and when the leaves unfolded it was seen that canker worms and tent-caterpillars were as abundant as in other seasons. Green and rosy aphids were also present and considerable damage may be charged up against them.

Rainfall was heavy in May and June, but a severe drought occurred in August and September.

There was the usual amount of damage from cutworms and wire-worms. The Colorado potato beetle was scarce, but the reason, we believe, was due not to the weather but chiefly to the abundance of its dipterous parasite *Doryphorophaga* (*Phorocera*) *doryphoræ* which was so common in 1913.

The winter nests of the brown-tail moth were unusually small, and many of them did not contain any living caterpillars in the spring. This may have been caused by the weather, but that point has not been determined. As a result the nests are few this winter, though they are scattered about as widely as usual and the insect has continued to spread toward the west.

Probably the chief entomological feature of the season, was the gypsy moth invasion, described on page 133. Next in importance is the army worm outbreak, described on page 157.

Grasshoppers were not especially prominent, and certainly did not cause notable injury as was the case in New York State where poisoned bait was used to control them.

Hickory trees have continued to die and in most cases the hickory bark borer is apparently responsible for their death.

The elm leaf beetle, which for many years has defoliated the elm trees near the sea level, has now become destructive at the higher altitudes, and in 1914 did more damage in such towns as Winsted, Norfolk, Canaan, Salisbury, Falls Village and West Cornwall than near the coast. People in these places are now adopting control measures for the first time.

MISCELLANEOUS INSECT NOTES.

Pink Grasshoppers.—On September 21, two pink grasshoppers or more properly angular-winged Katydidids were sent to the Station from Derby. These belong to the species *Scudderia furcata* Bruner. Though usually bright green, occasionally bright pink individuals are found, and several such captures are on record.

Abundance of *Polygonia interrogationis* on Elm.—The spiny brown caterpillars of this species were unusually common on elm in 1914, stripping branches and small trees. Hop, hackberry, nettle and linden are other food plants. The adult is known as the "violet tip" or "interrogation point butterfly" and is common on ripe fruits in autumn. It hibernates as an adult. (See plate XXIII).

Cherry or Pear Slug.—The cherry or pear slug *Caliroa limacina* Retz., occasionally does damage late in the season by eating the green tissue from the upper surface of the leaf often ruining it. In one of the nurseries, at inspection time, a block of pear stock had been attacked and on some of the young trees the leaves were ruined. Spraying with lead arsenate or hellebore will prevent this injury.

Rare Lady Beetles in Connecticut.—Since the publication of Bulletin 181, Some Common Lady Beetles of Connecticut, Mr. I. W. Davis has collected three specimens of *Harmonia similis* Rand, and four specimens of a northern form new to our list, *Anisocalvia 12-maculata* Gebl. The latter was known to occur in British Columbia, Minnesota, Michigan, New Hampshire, Utah, and possibly Northern New York State, but according to C. W. Leng, has never before been taken so far south as Connecticut.

The Tulip Tree Scale.—The tulip tree scale *Toumeyella liriodendri* Gmel., which was mentioned in the Report of this Station for 1912, page 294, is abundant and attracting attention. This year specimens were received from Killingworth, Deep River, Middletown, East Hartford, New London, Lyme and Ridgefield. Since publishing the note mentioned above, we have heard of certain cases of injury where the tulip tree was sprayed with mis-

cible oils. Spraying the dormant trees with lime-sulphur as for San José Scale is perhaps the best control measure.

The Strawberry White Fly.—On September 5, 1914, strawberry plants were received from Branford, which were quite badly infested with the strawberry white fly *Asterochiton* (*Aleyrodes*) *packardi* Morrill. Eggs, larvæ and adults were abundant on the underside of the leaves.

This insect is occasionally destructive, and the writer observed it in a strawberry field in West Hartford, June 30, 1905. In some cases in small garden plantations it may be possible to underspray the leaves with "Black Leaf 40" and soap to kill the adults and larvæ. Where large areas are infested this treatment would be impracticable and burning over the field in the fall would be the best method of destroying the pest.

The Chinch Bug.—Though causing great damage to grass, grain and other crops in the middle west, the chinch bug *Blissus leucopterus* Say, is seldom troublesome in Connecticut. It occurs here, however, as there are a number of specimens in the Station collection taken in New Haven and Orange. The late Dr. J. B. Smith in his list of the insects of New Jersey, states that it is a rare insect in that State and that its scarcity is due to climate and not to any particular parasites or other natural enemies. On September 5, the Director of this Station, brought in some specimens from Bristol, where they were found on some brown spots on a lawn. It is uncertain whether or not they were responsible for killing the grass in these small areas.

The Saddle-Back Caterpillar.—Each year the saddle-back caterpillar *Sibine stimulea* S. & A. is sent to the Station with requests for information regarding its status as a pest. We always run across these curious caterpillars when inspecting nurseries. They have a varied food plant list and we may expect to find them on almost any plant. The name comes from the characteristic markings of the larva, which is shown on plate XXIV, b. The four branched spines will cause an intense stinging and itching sensation when brought in contact with the human skin. The adult is a reddish brown moth with a wing-spread of about one and one-half inches.

The Hickory Leaf Stem Gall Louse.—Each summer hickory trees in Connecticut shed many of their leaves in June on account of the hickory leaf stem gall louse *Phylloxera caryæcaulis* Fitch. This insect makes galls on the petioles of the compound leaves and the stems often break off at the point where the galls occur. The presence of the galls and the fact that the stem breaks off leaving a portion on the tree, distinguishes this trouble from that caused by the hickory bark borer, where the entire compound leaf and petiole fall, the stem showing that it has been eaten at the base. There seems to be no practicable remedy.

Injury by Bill Bugs.—These insects cause much damage to young corn in the Middle and Southern States, by eating into the upper part of the stem. As the plant grows and the leaves unroll a row of holes across the blade is apparent. The blade often breaks over at this point. There are several species responsible for such injury all being snout beetles, weevils, or curculios of the genus *Sphenophorus*.

On June 15, specimens of *Sphenophorus sculptilis* Uhler, were received from Woodbury, together with some of the soil and several plants with leaves perforated in the manner described. Most of these bill-bugs breed in the roots of sedges and rushes in meadows, and it is well not to plant corn near such a place. Except for crop rotation, there is no other control measure known.

The Four-Lined Leaf Bug.—A number of samples of this insect and its injury are received each year. It attacks currants, gooseberries, parsnip, sage, mint, rose, dahlia, and many other plants. Slingerland* gives a list of fifty-seven kinds of plants, and common weeds. The injury is caused by sucking out the sap from the young terminal leaves, causing the formation of brown depressed spots. Later these leaves often become brown and dry. The four-lined leaf-bug, *Pæcilocapsus lineatus* Fabr., is rather more than one-fourth of an inch in length, bright yellowish green, marked above with four black longitudinal stripes. The eggs are laid in the stems of the plants and remain here through the winter, hatching late in May and early in June. The bugs become mature about the middle of June and remain and cause injury for about a month. Spraying with "Black Leaf 40" 1 teaspoonful in 1 gallon

* Bulletin 58, Cornell University Agr. Expt. Station, 1893.

of water with a little soap is the best remedy. This bug and its injury to currant leaves are shown on plate XX, b.

The Grape Plume Moth.—Every year in May and June, nearly all grape vines are infested by small spiny green larvæ which spin webs drawing together the new leaves at the tip of each terminal shoot. There is one larva in each nest thus formed and it feeds on the leaves inside. (See plate XXIV, a.)

Many samples and inquiries are received regarding this insect. As a matter of fact the injury is more apparent than real. The end of the shoot is seldom eaten, and therefore, the growth is hardly checked. Smith* states that "they do no real injury in most cases because as a rule they spin up the tip beyond the blossom cluster." On arbors the vines are rendered unsightly by its attacks, and remedies are sought. As the insect remains wholly inside the nest of folded leaves there is no way of reaching it by spraying. In large vineyards no remedial treatment is attempted. In the home garden, the simplest method is to crush each larva by pinching its nest with the thumb and forefinger.

The grape plume moth, *Oxyptilus periscelidactylus* Fitch, belongs to the lepidopterous family Pterophoridae, the moths having the wings split into separate plumes or feathers.

The Colorado Potato Beetle and Zinc Arsenite.—The Colorado Potato Beetle was unusually scarce in most Connecticut potato fields in 1914. In fact some growers did not find it necessary to use poison at all on their potatoes.

This scarcity may be partly explained by the fact that nearly all adults and larvæ noticed and collected by members of this department in 1913 bore the white eggs of Tachinid flies. Adult flies were reared from parasitized larvæ and were kindly identified by Mr. Harrison E. Smith as *Doryphorophaga* (*Phorocera*) *doryphorae* Riley.

At the Station farm in 1914, the potatoes were sprayed only once, on June 25, with poison. On most of the field lead arsenate was used but on ten rows on the west side powdered zinc arsenite was applied. The spraying was done by Messrs. Stoddard and Graham of the botanical department. No particular difference could be seen in the results of the application of the two poisons.

* Insects of New Jersey, page 536, 1909.

Both killed the larvæ satisfactorily, and there was no injury to the foliage.

Curious Pupæ of an Unfamiliar Fly.—On May 20, 1914, some curious specimens of an unfamiliar insect were received from Wallingford, Conn., with a statement that they were found close to the crowns of strawberry plants. The correspondent wished to know what they were, what harm they did, and how to get rid of them. We could not give this information, but acknowledged the receipt of the letter and specimens, placed the latter in a breeding cage in the insectary and on June 1 obtained an adult two-winged fly. Another emerged June 15th. The material was kindly identified by Mr. C. W. Johnson as *Macrosargus cuprarius* Linn., supposedly a European species which during the last few years has been found to be rather abundant and widely distributed in the United States.

The pupæ were gray, about 10 mm. long, nearly 3 mm. broad and less than 2 mm. thick. The lateral margins are nearly parallel for about three-fourths of the length from the anal extremity, then taper toward the head which is narrow, elongated, with a hemispherical projection on each side resembling an eye. The segmentation is prominent throughout.

The Walnut Caterpillar.—Occasionally the Walnut Caterpillar *Datana integerrima* G. & R. is abundant in Connecticut and is found in clusters on black walnut, butternut or hickory trees stripping them. (See plate XIX, b.)

On August 12, nearly a pint of the caterpillars were brought to the Station from North Haven, where they were gathered from the trunk of a tree. The larvæ have this habit of resting in clusters on the trunk or under side of the branches like a piece of gray fur. The full grown caterpillar is slightly less than two inches in length, body black and covered with long whitish hairs, head black and shiny. The adult is a light reddish brown moth with wings marked transversely with lighter and darker bands and lines. It has a wing-spread of nearly two inches, and closely resembles the moth of *D. ministra* Dru., the adult of the yellow-necked caterpillar of the apple.

Leaf Hopper Injuring Japanese Barberry.—On July 23 two badly crushed specimens of a large leaf hopper were received from Mr.

W. A. Muirhead, Superintendant of Trees, City of Hartford, accompanied by a statement that they were injuring Japanese barberry. Mr. Walden who was then in charge of the office during the vacation of the writer, identified the leaf hoppers as belonging to the genus *Gypona*, but they were too badly crushed for specific recognition. At the writer's request Mr. Muirhead sent more material. Some of this was sent to Prof. Herbert Osborn one of our leading authorities on this group, who identified the species as *Gypona flavilineata* Fitch. Mr. Muirhead was advised to spray with a nicotine solution. This he did and under date of July 27, wrote that he had tried Black Leaf 40, 1 pint in 100 gallons water, but that it seemed to have but little effect. The leaf hoppers at this time were about mature and probably needed a more concentrated solution. Perhaps earlier in the season it might prove effective on the nymphs.

Controlling Green Apple Aphis.—Late in July it was noticed that the apple trees in the young orchard at the Station farm at Mt. Carmel were badly infested with the green apple aphid, *Aphis pomi* Deg. The trees were set in the spring of 1910. The lice were nearly all on the leaves and stems of the terminal shoots, and the leaves were more or less curled. Though the trees had made nearly all their growth for the season, it was thought best to destroy the aphids. Consequently Messrs. Lowry and Zappe on July 25, 30 and 31 dipped the ends of the branches in a pail of liquid to kill the aphids. Beginning on the south side the rows running east and west were treated as follows:

Rows 1 to 6. Pratt's nicotine, 1 teaspoonful in 3 quarts of water, with soft soap.

Rows 6 to 9. Imp Soap, 1 pint in 14 quarts of water.

Rows 9 to 17. Black Leaf 40, 1 teaspoonful in 1 gallon of water.

The trees were carefully examined August 6. Only a few living aphids were found on rows 1 to 6. None were found on any of the other rows. On small trees dipping is far more effective than spraying, and this trial shows that by this treatment the aphis can be controlled at least on small trees.

Mites on California Privet.—California privet is seldom injured by mites and it is doubtful if any species has heretofore been recorded from it unless, possibly "red spider." A short hedge of

this plant growing in the writer's garden was attacked early in the summer of 1914 by a mite which Mr. Nathan Banks has kindly identified as belonging to the genus *Phyllocoptes*. Apparently it is a new species.

Nothing unusual was noticed on this hedge in 1913, but the present season, the first growth had peculiar slender shoots with the narrow leaves curled backward. On examining them with a hand lens, the under side of each leaf was found to be literally covered with very small, elongated, crawling mites. Previous to July 1st, apparently all terminal shoots on this hedge bore infested and curled leaves. The hedge was allowed to remain without trimming or spraying. The writer returned from a vacation late in July, when the hedge presented a changed appearance as a number of the stronger shoots were normal and the mites had then disappeared from all of the leaves.

Harlequin Cabbage Bug in Connecticut.—The first and only record which we have of this insect occurring in Connecticut, is a single specimen collected at Meriden, July 4, 1910, by Mr. Harry Johnson. Mr. Walden visited Meriden and looked over Mr. Johnson's collection and saw this specimen and obtained it for the Station collection.

In the Southern states the Harlequin Cabbage Bug *Murgantia histrionica* Hahn, is an important cabbage pest. In the "Insects of New Jersey" Smith states that this southern species under certain conditions extends into New Jersey and has been taken as far north as Morris County which is in the latitude of New York City.

In a recent letter Mr. F. A. Sirrine informs the writer that he has not seen the Harlequin Cabbage Bug on Long Island since 1894, and that it has never done any harm there. This being the case one need hardly expect it to become a pest in Connecticut.

The most important control measures are cleaning up and destroying all cabbage refuse in the fall and planting early in the spring trap crops of kale or mustard upon which the young bugs may be killed by a spray of kerosene emulsion.

European Pine Shoot Moth.—On August 10 Mr. August Busck of the Bureau of Entomology called at the office and stated that he happened to be in Connecticut and was looking about to see if he could find the European Pine Shoot Moth present; that it had evidently been introduced into this country from Europe and was

abundant on Long Island. This insect attacks the Scotch, Mugho and probably some other species of pines in Europe. On Long Island Scotch pines were attacked. The writer understood that Mr. Busck did find it in Connecticut. Mr. Busck published an article calling attention to this insect in *Journal of Economic Entomology* for August, page 340. The larvæ pass the winter in holes eaten in the buds and in the spring begin to feed upon the growing buds often feeding upon one side only causing a curved growth.

The adults reared from the Long Island material enabled Mr. Busck to readily identify the species as *Evetria buoliana* Schiff, one of the small Tortricid moths closely related to the Nantucket Pine Moth which has caused so much damage.

It is yet too early to recommend control measures for this insect but all growers of pine trees should be on the watch and should report at once to this office sending specimens in case any are found.

The Oak Pruner.—A number of complaints are received each year of damage to shade trees by a borer in the twigs which causes them to break off and fall in midsummer. The oak is the tree most commonly attacked, but maple, apple and other trees are sometimes injured. During 1914 this form of injury has been sent to the Station from Fairfield, Middletown, Milford, New Haven, Salisbury and South Killingly. The insect causing this trouble is a long-horned or Cerambycid beetle *Elaphidion villosus* Fabr.

According to Chittenden* this insect is found from New England through the eastern United States westward to Michigan and as far south as North Carolina and Texas. The egg is laid on a small twig in early summer. The minute larva tunnels in the wood under the bark following the grain toward the base of the branch. When nearly full grown it cuts the branch nearly off. This breaks in the first strong wind and falls to the ground with the insect in the severed portion. The larva withdraws into its burrow and plugs the opening with sawdust, then pupates and the adult beetle appears the following spring.

The injury is usually not serious, but the litter on a lawn soon becomes a nuisance. As the borers fall with the twigs, collecting and burning them will help as a control measure. This is the only

* Bureau of Entomology Circular 130, 1910.

treatment to be recommended, and if carried out generally and thoroughly will result in diminishing the number of pruners the following season.

Abundance and Control of Pear Psylla.—In many pear orchards in 1914, especially where the dormant trees were not sprayed with lime-sulphur, the pear psylla did considerable damage, causing some of the leaves to fall in July and on the remaining leaves and on the fruit which was covered with "honey dew" the black mold grew abundantly, giving it the appearance of having been sprinkled with soot. The sooty appearance at harvest time, of course, renders the fruit unsalable and for this reason several growers wished to spray in July or early in August to clean up the fruit. Mr. W. F. Platt of Milford, is one of the fruit growers who sprayed about August 1st with "Black Leaf 40" one-half pint in 50 gallons of water. Mr. Platt was well satisfied with the treatment as it seemed to kill the insects and to clean up the fruit.

In order to test the effect of this mixture on the pear psylla, Mr. Zappe sprayed portions of a large pear tree on the Station grounds. One branch was treated with the "Black Leaf 40", 1 pint in 50 gallons of water containing soap, and another branch with the same preparation, $\frac{1}{2}$ pint in 50 gallons. There were many adults on the branches at the time of the treatment. Most of them flew into the air but were hit with the spray and brought down. A white cloth was spread under the tree and caught all that fell upon it. It was thought that possibly the psyllids were stupefied by the spray and that they might recover. This cloth was, therefore, brought into the laboratory and watched. Apparently not a single psylla recovered or showed any signs of life after being hit with the weaker nicotine solution.

The Stalk Borer.—The stems of herbaceous plants are often attacked by a larva which tunnels up and down in the pith, causing the stem to wilt and die. Though there are several species thus attacking different plants, one of the commonest is called the Stalk Borer, *Papaipema nitela* Guen., formerly *Gortyna nitela*. This species is also a general feeder and is known to attack many native weeds and such cultivated plants as corn, potato, tomato, aster, lily, dahlia and many others. In 1914, stalk borers were abundant and there was much injury, especially to dahlias. The larva enters the stem and is seldom noticed until the leaves at the

top begin to droop. Then a careful inspection will show that a borer is at work in the stem. By cutting a slit lengthwise of the stem it is possible to kill the borer without greatly injuring the plant. As a rule, however, so much eating has been done before the pest is found that the shoot does not recover and blossoms can be obtained only from axillary branches which grow afterward. The larva is about an inch long, dirty white striped longitudinally with yellowish-brown stripes with a brown girdle covering three or four segments back of the true legs. The adult of the stalk borer is a Noctuid moth having a wing-spread of about one and one-half inches, and gray in color with a cluster of conspicuous white and yellow dots near the center of each fore wing.

This insect and its work has been received in 1914 from Mystic and New Haven in dahlia, from Pomfret in corn, and from Simsbury in tobacco.

There are some species of the genus *Papaipema* which feed only in the stems of certain plants, and Mr. Henry Bird of Rye, N. Y., has bred and described a number which proved new to science.

Injury to Geraniums by White Ants.—On May 23, a Hartford florist wrote to this office describing a trouble of bedding geraniums (*Pelargonium zonale* or other species) in the field of a customer at New Rochelle, N. Y. More than 200 plants had been ruined by some insect which tunneled out the inside of each stem and main root. The plants, of course, soon turned yellow, wilted and died.

From the description we failed to recognize the trouble, and advised to have the customer send specimens if possible. In due time, about July 1, we received from New Rochelle, a stem from one of these plants together with some of the soil in which it was grown. In the stem and in the soil there were a few immature termites or white ants, probably belonging to the genus *Termes*, which undoubtedly were the cause of the trouble. They had devoured the entire inner portion of the stem leaving only a thin outer layer of the woody tissue and bark.

Termes flavipes Kollar is our commonest species and often breeds in woodwork near the ground, such as fence posts, bridges, trestles, buildings, etc. We have found it in old stumps, in the board walks of greenhouses, and in the strips of wood along the edges of tar walks. One winter they were quite abundant in the Station greenhouse. The writer observed swarms of them a few

years ago emerging from the board strips along the sidewalk on Church Street, New Haven, next to the "Green."

At New Rochelle, however, the white ants could not be traced to any woodwork but seemed to be all through the soil. They may, therefore, belong to a different species, but as our material was immature we could not identify it. There are several destructive kinds in the tropics and at least six species in the Southern United States.

On a visit to the Bussey Institution, Forest Hills, Mass., July 7, I was shown a geranium stem which had been hollowed out by white ants in exactly the same manner as those from New Rochelle.

A possible remedy is carbon disulphide used in the soil as for ordinary ants, but many tests must be made before any treatment can be recommended.

False Apple Red Bug in Connecticut.—For three seasons at least, red bugs have been present and caused considerable damage in the apple orchards at Conyers Manor, Greenwich, Conn. We did not see specimens of the insects responsible for the damage, nor visit the orchard, until August, 1914, too late to find the bugs at work. The species was not identified.

During June, 1914, Mr. Zappe discovered some red bugs at work on the leaves of some small apple trees planted in nursery rows on the Station grounds. These trees bore no fruit but the leaves had been curled, red-spotted, and distorted by the bugs as shown on plate XX, a. The species causing the trouble seemed to be the false red bug *Lygidea mendax* Reut., and this identification was later confirmed by Mr. O. Heidemann of the U. S. National Museum at Washington, D. C. This insect is shown on plate XX, a.

There are two similar species injuring apple, the red bug *Heterocordylus malinus* Reut., and the false red bug *Lygidea mendax* Reut. Both belong to the family Capsidæ. Not only do these two species look much alike to the untrained observer but they cause similar damage to the fruit and foliage, by sucking out the sap. Their punctures in the young fruit cause it to develop unevenly resulting in irregular or gnarled fruit, and the leaves are also curled and distorted by them.

Both species were described by the late Doctor O. M. Reuter of Helsingfors, Finland, in *Acta Soc. Sci. Fennicæ* XXXVI, pp. 47, 71, 1909. The best economic account of these insects may be

found in Bulletin 291 of the Cornell University Agricultural Experiment Station, by C. R. Crosby, published under date of January, 1911.

Any one noticing the presence of red bugs in 1915, or the injury caused by them, should communicate with the State Entomologist.

Mr. Crosby found in New York State that red bugs could be controlled by thoroughly spraying with "Black Leaf 40", $\frac{1}{2}$ pint in 50 gallons of water, to which about 2 pounds of soap has been added. This nicotine solution may be used in combination with lead arsenate, lime-sulphur, or Bordeaux mixture in the regular spray treatment. Soap is hardly necessary when the nicotine is used thus in combination.

The Hickory Bark Borer.—In the Report for 1913, page 237, is an account of the hickory trees dying on the Station grounds and elsewhere in the vicinity. It is true that following a severe drought a few trees died and that we could find few bark beetles present—not nearly enough to have caused their death. On the other hand, sections of the trees were placed in breeding cages and all insects emerging from the wood or bark were caught and saved. A considerable number of weevils *Magdalis olynx* Hbst., were bred from these trees.

Other trees did not put out leaves in the spring of 1914 and most of these showed abundant evidence of the attacks of the hickory bark borer *Scolytus quadrispinosus* Say., and were removed. Late in June several trees which had previously appeared healthy began to drop their leaves which had been eaten partially off at the base by the adult beetles. On July 3, these trees were thoroughly sprayed with powdered lead arsenate, 4 pounds in 50 gallons of water. It was rather late for the treatment anyway and there was not much opportunity to observe the result. Many leaves had been eaten partially off before the spraying and continued to break and fall for sometime afterward. Nevertheless more fresh leaves dropped from an unsprayed tree nearby than fell from the sprayed trees. This insect and its work are shown on plates XXI and XXII.

Particularly where lead arsenate and "Black Leaf 40" were used dead beetles were found on the tar walk underneath the trees on July 5, and a few were observed each time we looked for them until about the first of August. Next year we shall spray again at least a month earlier in the season.



a. View in Field showing an Infested Plant among Healthy Ones.



b. Cabbage Stems Hollowed out by Maggots. Nearly Natural Size.



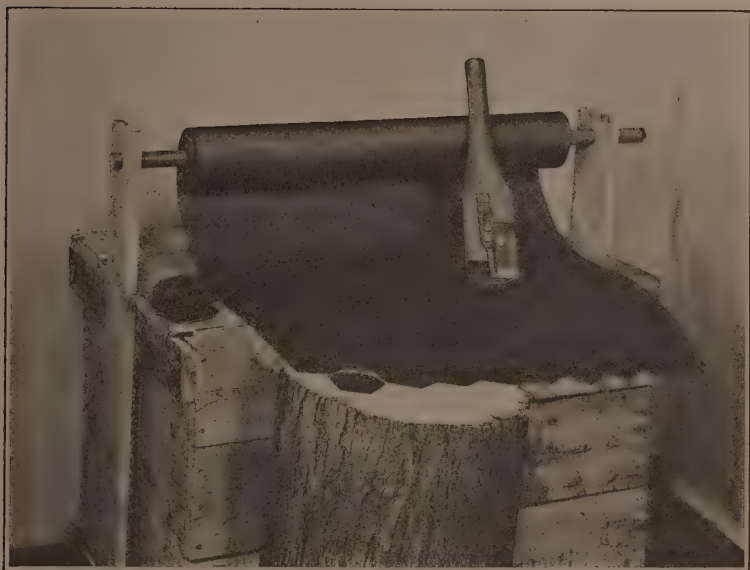
a. Young Cabbage Plant showing Maggots on outside of Stem. Natural size.



b. Plant Protected by Tarred Paper Disk.



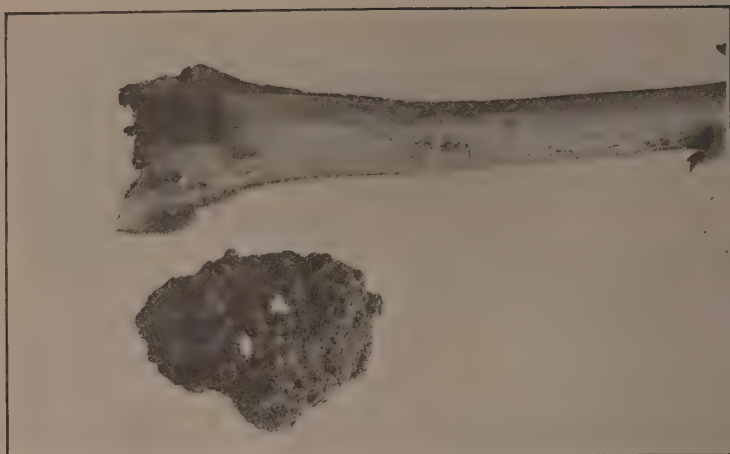
a. Turnips Injured by Maggot.



b. Tool and Device for Cutting Disks.

THE CABBAGE MAGGOT.





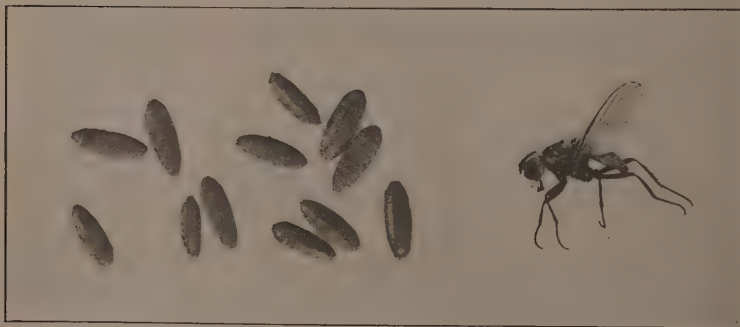
a. Eggs of the Cabbage Maggot. Twice natural size.



c. *Hadenæ turbulenta* Hubn.
Natural size.



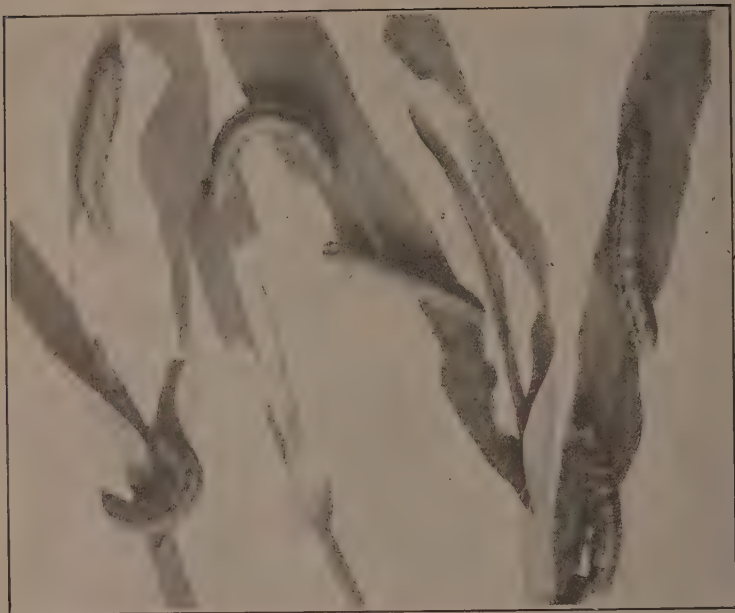
d. Larvæ of *Hadenæ turbulenta* Hubn.
Natural size.



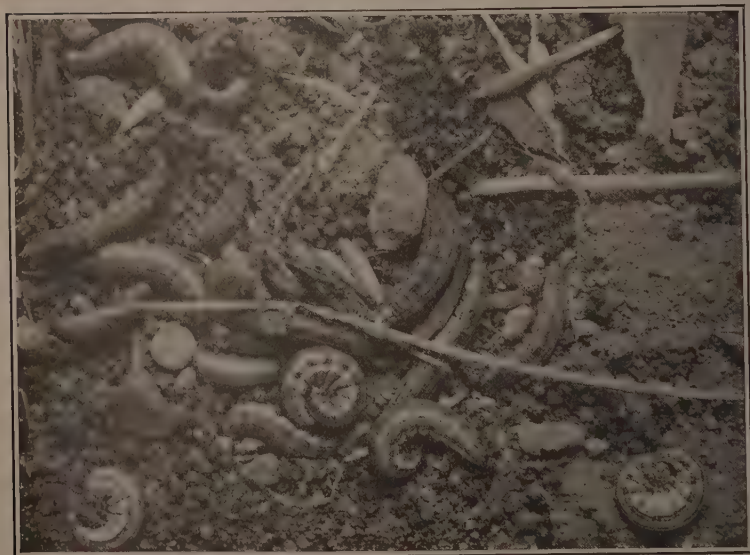
b. Puparia and Adult of the Cabbage Maggot. Enlarged.



THE ARMY WORM:



a. Caterpillars Feeding on Grass.



b. Caterpillars Coiled up under Straw.

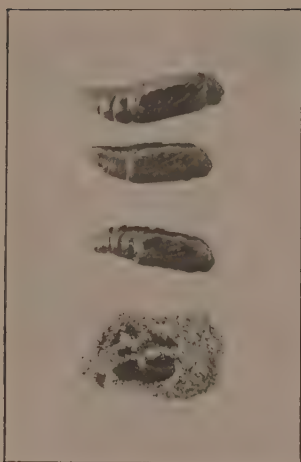
THE ARMY WORM.



a. Caterpillars killed by Wilt Disease hanging on Grass Stalks and Leaves. Twice natural size.



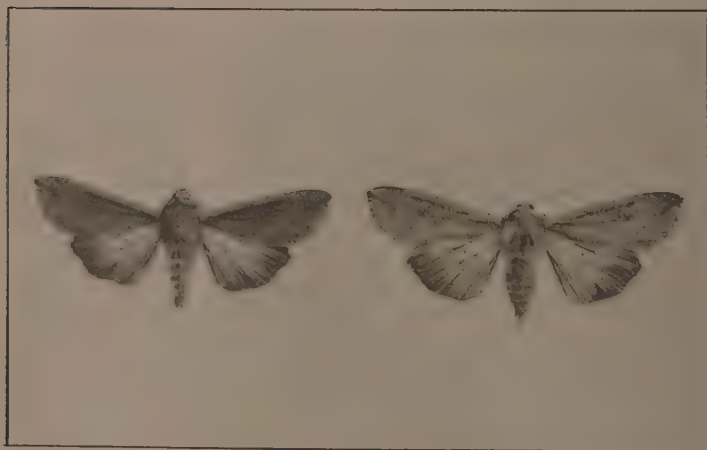
b. Caterpillars showing Tachinid Eggs. Twice natural size.



a. Pupæ. Natural size.



b. A Tachinid Fly
Winthemia quadri-
pustulata Fabr.
Twice natural size.



c. Army Worm Moths. Natural size.



a. View in New Canaan showing Infested Oat Field, with a Swath Cut and a Furrow Plowed to check the Army Worms.



b. Another View showing Furrow Plowed between Oats and Corn.



a. Method of Collecting Weevils in White Pine Plantations.

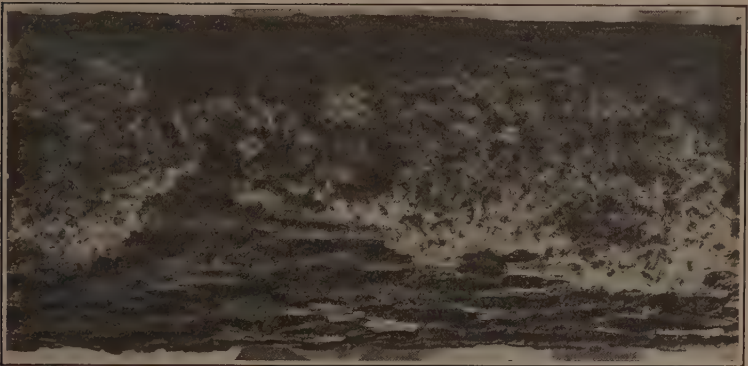


b. Spraying Infested Plants in Greenhouses.

CONTROLLING THE WHITE PINE WEEVIL AND A MITE
ON SNAPDRAGON PLANTS.



a. Shoot of Snapdragon Plant showing Leaves Curled by Mites and the Clean Growth after Treatment.



b. Walnut Caterpillars Clustered on Trunk of Tree.



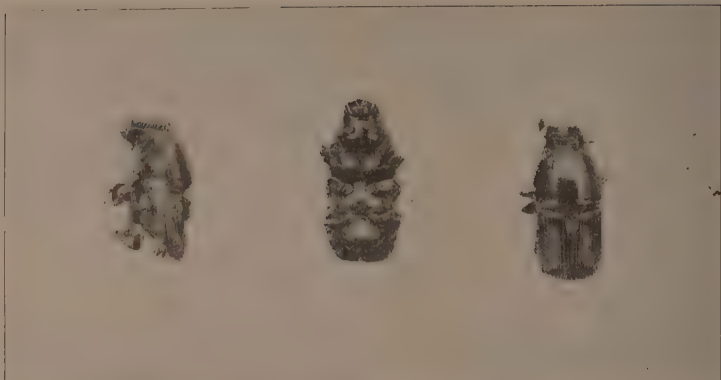
a. Apple Leaves Injured by the False Red Bug.
Leaves natural size, Bug nearly three times enlarged.



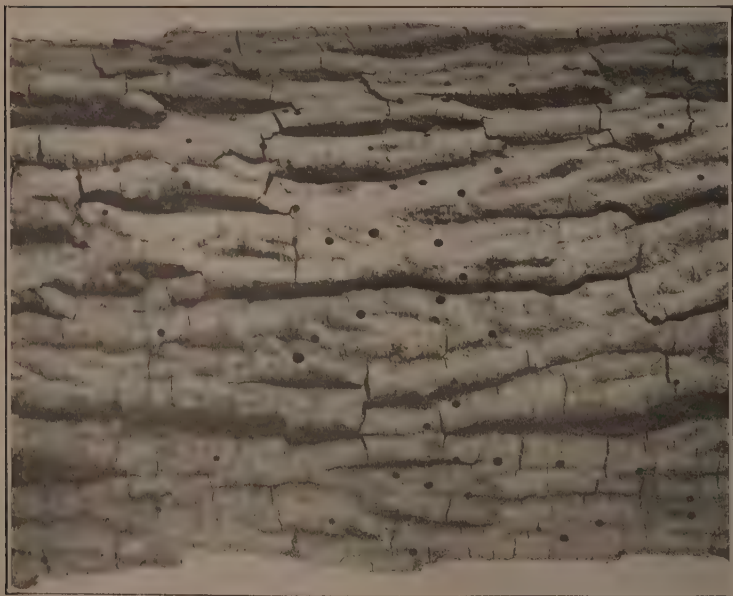
b. Currant Injured by the Four-Lined Leaf-bug.
Leaves natural size, Bug twice enlarged.



Trees on Station Grounds Killed by the Hickory Bark Borer.



a. Beetles, much enlarged.

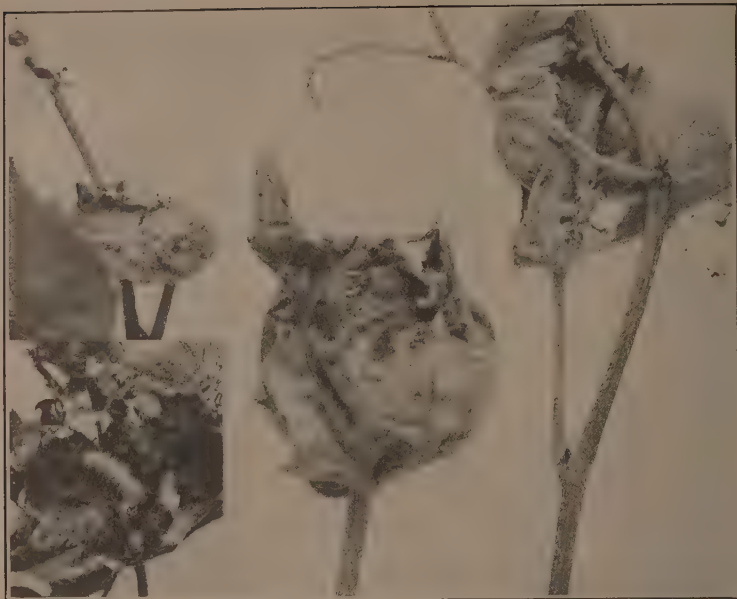


b. Holes in Bark, where Beetles Emerged.

THE HICKORY BARK BORER.



Caterpillars, Cocoon and Adult of the Violet Tip Butterfly.



a. Folded Grape Leaves. Larva in Lower Left-hand Corner.
All natural size.



b. Saddle-back Caterpillars Feeding upon Cat-tail Flag. Natural size.
THE GRAPE PLUME MOTH AND THE SADDLE-BACK
CATERPILLAR.

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